Open Water Diver Manual

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Contents

How to Use This Manual 1

Using the DVD and Manual 1

Start with the DVD 1
Go Through the Manual 2
Complete the Study Questions 2

Unit One 3

The Science of Diving 3

Buoyancy 3
Seeing Under Water 5
Hearing Under Water 6
Heat Loss in Water 7
Pressure 8
Pressure's Impact on Volume and Density 9
The Impact of Increasing Pressure on Body Air Spaces 10
The Impact of Decreasing Pressure on Body Air Spaces 12
Avoiding Lung Overpressure Injuries 13
Breathing Under Water 15
Nitrogen Narcosis 16
Decompression Sickness 17
Oxygen Toxicity 21
Carbon Monoxide Poisoning 22
Shallow Water Blackout 24

Unit Two 27

The Aquatic Environment 27

No Two Sites the Same 27
Water Temperature 28
Bottom Composition 29
Diving Around Coral 30
Visibility 31
Diving in Extremely Clear Water 32
Aquatic Life Interaction 33
Aquatic Plants 34

Water Movement..... 35
Currents....35
Waves and Surf....36
Surge....38
Longshore Currents....38
Rip Currents....39
Upwellings....39
Tides....40

Unit Three..... 41

The Most of Personal Dive Equipment..... 41
Dive Masks....41
Scuba Fins....43
Snorkels....45

The Scuba Unit..... 47
BCs....47
Weight Systems....49
Scuba Tanks....52
Scuba Regulators....56
Instruments and Gauges....60

Exposure Protection..... 62
Exposure Suit Overview....62
Dive Skins....63
Wet Suits....63
Exposure Suit Accessories....64
Dry Suits....66

Additional Equipment Items..... 66

Unit Four..... 69

Dive Planning..... 69
Advance Preparation....69
Equipment Preparation....70
Spare Parts Kit....70
Pre-Dive Preparation....71

Problem Recognition And Control 72
Problems at the Surface 72
Basic Diver Assistance Concepts 73
Overexertion 74
Out-of-Air Emergencies 74
First Aid for Diving Emergencies 78
Boat Diving 79
Pre-Dive Preparation 79
Boat Diving Procedures 79
Equipment Management 81
Buddy System and Communication 82
Managing Exposure to Nitrogen 84
No-Decompression Limits (NDLs) 84
Residual Nitrogen 85
Introduction to Dive Computers 86
Dive Computer Modes 86
Dive Computer Features 87
Using Your Computer at Altitude 89
Using Computers Safely 90
Computer Diving Procedures 91
Flying After Diving 92
Dive Tables 93
Odds and Ends 94
Logging Your Dives 94
Underwater Navigation 96
Dive Flags and Floats 97
Diving and Your Health 98
Standard Safe Diving Practices 98
Special Concerns for Female Divers 100
Continuing Education 100
Nitrox Diver 101
Advanced Open Water Diver 101
Rescue Diver 102
Specialty Diver Training 102
Master Scuba Diver 102
Leadership Training 103

Unit Five 105

Diving Skills 105

The Six Rules of Recreational Scuba 105

Dive Like a Fish 106

Scuba Unit Assembly 108

Scuba Unit Disassembly 113

Donning Mask and Fins 114

Donning Your Mask 114

Donning Fins 115

Regulator Recovery and Clearing 116

Regulator Clearing and Airway Control 117

Regulator Recovery 118

The Best Solution is Prevention 120

Mask Clearing 121

BC Use 124

Familiarization and Visualization 124

BC Deflation at the Surface 125

BC Inflation Under Water 126

BC Inflation at the Surface 127

Practicing the Three *A*s 128

Diving Like Fish 129

Swimming Under Water 130

"Look Ma, No Hands!" 130

Effective (and Ineffective) Kicks 130

"WWBCD" (What Would Barry Cuda Do?) 132

Deep Water Entries 132

Alternate Air Source Use 134

Congratulations… 135

How to Use This Manual

The NASE *Open Water Diver Manual* is designed to be used in one of two ways:

- If you are taking the NASE Open Water Diver course on line: The manual serves as a convenient reference for when you are not able to look up information on line, or when it is simply faster to look up information in the Table of Contents than it is to flip through pages in the online course. If you take the online course, you *do not* need to complete the Study Questions mentioned at the end of each unit.

elearning
The Next Wave in Diver Training
Buoyancy
Study Questions As you watch the video, look for the answers to the following:
What are the three states of buoyancy, and under what conditions might divers want to achieve each state?
What tools do divers use to help control buoyancy?
Buoyancy
Key Points
Objects that displace more water than they weigh float, and are positively buoyant. Divers will want to be positively buoyant when resting or swimming on the surface.

- If you *are not* taking the course on line: The manual is designed to work with the NASE Open Water Diver course DVD and Study Questions (i.e., "the homework") in ways that will help ensure the best comprehension and retention of critical information.

Using the DVD and Manual

Different people learn best in different ways. The DVD, manual and Study Questions accommodate a variety of learning styles. In so far as repetition is key to learning, these materials work together to enable you to go through the same information several times — but always in different ways.

Outlined below is a method we recommend. You can modify it, as needed, to meet your own individual needs.

Start with the DVD

You can either watch the entire DVD all the way through — or you can watch just a single unit, then go through the corresponding unit in the manual and Study Questions. When you go through the manual, you may notice a few, very minor discrepancies between the DVD and manual, chiefly in the area of dive equipment. Of the two, the manual is newer and reflects the latest in equipment technology.

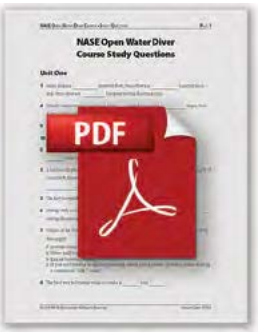
Go Through the Manual

Rather than simply reading the manual from cover to cover, as you would a novel, we recommend the following:

- *Begin by flipping through the unit or section you wish to read:* Look at pictures, captions, chapter headings and subheadings. Doing so will give you a better feel for the section's organization and structure, and an overview of what you are about to learn.
- *Identify the learning goals:* At the start of each section, you will find a list of questions entitled *What to Look For.* These will help you identify the most important information in each section.
- *Highlight important information:* As you read through each section in depth, highlight or underline the information that specifically answers the learning goal questions asked at the beginning of the section (as well as any other information you think is important). Doing so will help you when you come back and answer the Study Questions later on.

Complete the Study Questions

Yes, there is homework associated with the course — but it's homework that will not only help you pass the final exam the first time you try, it will also ensure you achieve the highest possible comprehension and retention of critical knowledge and skills.



The Study Questions are an Adobe Acrobat PDF. Your instructor will either give you a printed or electronic version, or you can download it from the NASE student website (*ScubaNASE.com*).

The electronic version of the Study Questions employs the latest Adobe Acrobat technology. This means you can complete them *on your computer*, then save and send the results back to your instructor. Not only is this easier and more legible than writing out answers by hand, it helps the environment by saving paper. And, the sooner your instructor can determine what you know, and what you may need a little help with, the better.

Whether you use the method outlined here, or another one better suited to your individual learning style, it is very, very important you have all the Study Questions completed and ready to turn in (or, better still, *turned in*) prior to the start of class. Your instructor will not allow you to participate if you do not.

Unit One

The Science of Diving

Being under water affects everything from what you effectively weigh to how you see, hear and breathe. It can have significant impact on your body's air spaces. It can also put you at risk for some maladies that just can't happen out of the water. The good news? Any potential problems are easily avoidable with just a little understanding.

Buoyancy

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are the three states of buoyancy, and under what conditions might divers want to achieve each state?*
- *What tools do divers use to help control buoyancy?*

When placed in water, some objects float, some sink and some neither float nor sink. Why they do so depends not only on how much objects weigh, but also on how much water they displace.

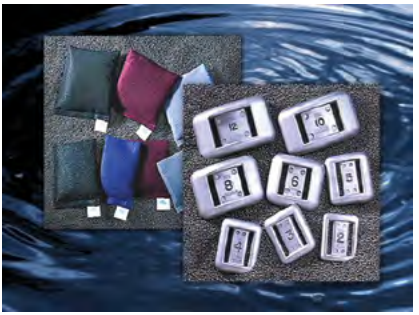
- Objects such as boats and bottle corks, which displace a volume of water that weighs *more* than these objects do, float. We call this being *positively buoyant*. Divers want to be positively buoyant when resting or swimming at the surface. Doing so allows them to conserve energy and keep their heads above water, where they can see what is going on around them — as well as see and talk to their buddies.
- Objects such as fish and submarines, which displace a volume of water that weighs *the same* as these objects do, neither float nor sink. We call this being *neutrally buoyant*. Neutral buoyancy is the ideal state for divers under water. Being neutrally buoyant makes diving easier, safer and considerably

more fun. More importantly, it helps prevent damage to the aquatic environment.

- Objects such as boat anchors and lead weights, which displace a volume of water that weighs *less* than these objects do, sink. We call this being *negatively buoyant*. Divers may wish to be *slightly* negative when descending, or when momentarily resting on the bottom to deal with a problem. In general, though, divers should avoid being negatively buoyant.

Divers use a variety of tools to control buoyancy.

- To offset the body's natural buoyancy and that of some equipment items, such as wet suits, divers carry lead in the form of block or soft weights. How much depends on a variety of factors, such as salinity. (You need between 2-3 kg/4-6 lbs more lead in salt water than in fresh.)
- To offset the loss or gain of buoyancy caused by the compression and expansion of wet suits at depth, divers add or remove air from their *BC* (a piece of equipment covered in Unit 3) air cell.
- You can make minor, temporary changes in buoyancy just by changing how deeply you breathe. The ability to do so is the mark of a very capable diver.



This is a good time to mention one of the five cardinal rules of scuba diving, Rule Number Five. That is: *Do not overweight yourself.* Always use the least weight possible. We will discuss buoyancy and the tools you use to control it further throughout the course.

Seeing Under Water

What to Look For

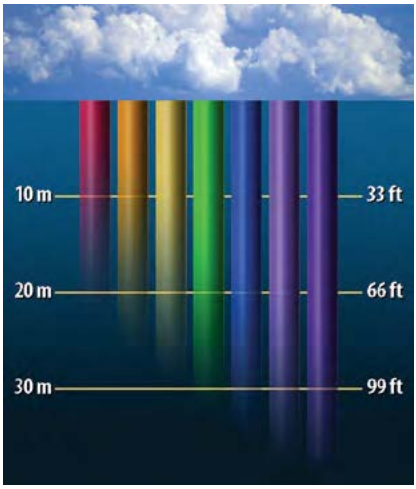
As you read through this section, highlight or underline the answers to the following:

- *What is refraction and how does it affect what we see under water?*
- *What happens to sunlit colors as you go deeper (and how can you compensate for it)?*
- *How can sedimentation and algae affect color and light under water?*

What we see under water is often affected by factors such as *refraction*, *absorption* and *sedimentation*.

Refraction: As light passes from water to air, it bends, creating a magnifying effect. As a result, objects under water appear *25 percent closer* and *one third larger* than they do in air. Refraction also affects our eyes' ability to focus under water. As a result, we cannot see clearly unless we have an air space in front of our eyes — which, fortunately, masks provide.

Absorption: As sunlight passes through water, the water absorbs certain colors of the spectrum. Reds and oranges are the first to go, followed in order by yellows, greens, certain blues, indigos and violets — basically all the colors of the spectrum. Eventually, only dark blues, grays, black and whites remain. To restore some of the color objects might display if closer to the surface, many divers carry lights with them on deeper dives, even during the day.



Sedimentation and Algae: Suspended particles (and some naturally occurring chemicals) can speed up the absorption process, causing divers to lose both light and color faster. Suspended algae in fresh water can also give the water a decidedly greenish cast.

Hearing Under Water

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *How much faster does sound travel under water?*
- *How does this affect our ability to hear under water?*
- *What should you do if you hear an approaching vessel while under water?*

Above water, we are able to determine the direction from which a sound originates because of the tiny difference between when that sound reaches one ear and when it arrives at the other. Under water, sound travels *four times faster* than it does in air, making it difficult to determine the direction from which a sound, such as a boat engine or propeller, may be approaching.

Sound also travels farther under water, making it harder to determine how close the source of a sound may be. If you hear the sound of an approaching vessel under water, remain close to the bottom and do not ascend until the sound has passed.

Heat Loss in Water

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *How much faster does your body lose heat in water?*
- *How may heat loss vary among divers?*
- *What should you do if you begin shivering uncontrollably while under water?*
- *What is the best way to prevent heat loss while diving?*

Under water, your body loses heat 25 times faster than it does in air. This makes being in 20° C/68° F water as potentially chilling as 4.5 C/40° F air.

Heat loss varies among divers. The greater your body's surface area in proportion to its mass, the faster you will lose heat. This often causes women to lose heat faster than men.

Shivering is the body's warning that something is wrong. If you begin shivering under water, it is time to end the dive and get warm. Failure to do so can be dangerous.

The best way to deal with heat loss under water is to prevent it by wearing adequate exposure protection. New divers, in particular, frequently underestimate the amount of exposure protection they will need. It is a rare body of water that is so warm you will not benefit from wearing at least a full-length, 3 mm or thicker wet suit.

A good barometer of what you need to be wearing in water of any temperature is to see what local dive instructors and dive guides use. As these professionals have to be in this water as often as every day, it is unlikely they will choose to be uncomfortable by underdressing for the cold.

Pressure

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is the source of the pressure we experience at sea level and under water?*
- *What is the relationship between pressure and depth?*

The pressure we experience at sea level results from the weight of the atmosphere above us. For example:

- A column of air, one centimeter square, extending from the surface of the earth to the upper reaches of the atmosphere weights roughly one kilogram.
- A similar column of air, one inch square, weighs 14.7 pounds.

This means that, at sea level, the atmosphere exerts a pressure of roughly 1 kg/cm^2 or 14.7 lbs/in^2 over the surface of our bodies. We refer to this as *one ATmosphere Absolute* (1 ATA).

Under water, the pressure we experience results from the *combined* weight of the water and air above us. Water is nearly 800 times denser than air. This means that, under water, pressure increases far more rapidly.

A column of water just 10 m/33 ft high weighs as much as a column of air of the same diameter that extends to the upper reaches of the atmosphere. This means that the *ambient* or surrounding pressure we experience under water will have doubled by the time we reach a depth of 10 m/33 ft. As the chart on page 9 shows, water pressure will continue to increase by 1 ATA for every 10 m/33 ft.

Pressure's Impact on Volume and Density

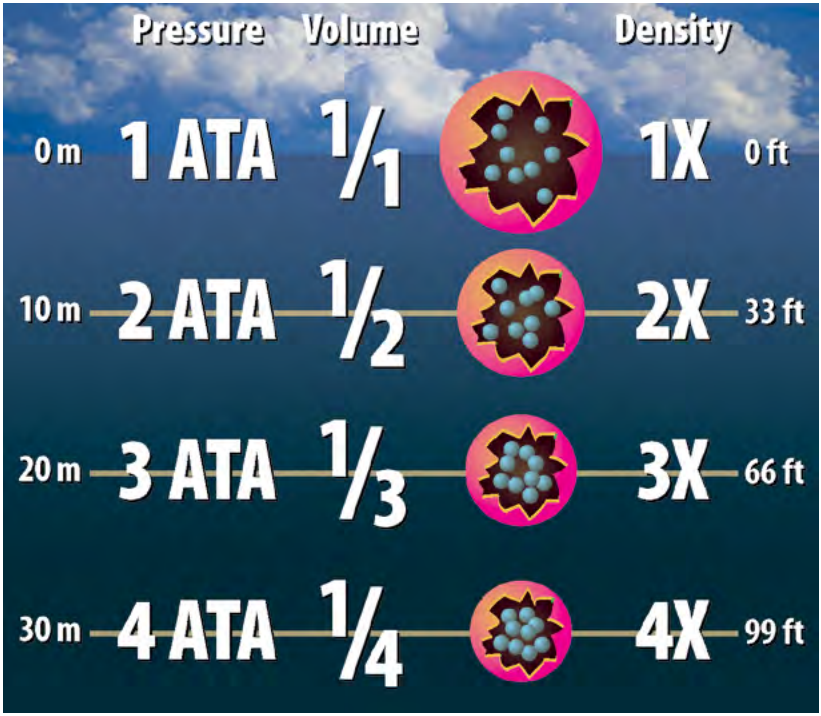
What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is the relationship between pressure, volume and density?*
- *How does the increased density of the air we breathe at depth affect gas consumption?*

While solids and liquids are relatively incompressible, gas mixtures such as air are *highly* compressible. This means that gas molecules in a flexible container, such as a balloon, will be squeezed closer together as we descend and the pressure on the balloon increases.

As the accompanying table shows, this relationship between pressure and volume is inversely proportional. If you double the pressure, the volume decreases by half; triple the pressure, and the volume reduces by two thirds.



As you look at the chart, you should notice two things:

- While pressure increases at a constant rate as we descend, the *volume* change caused by pressure is greatest near the surface.
- Although the volume of gas in a flexible container decreases as we descend, the container still has the same number of gas molecules inside; they are simply squeezed closer together.

Increased Density's Impact on Gas Consumption: Scuba regulators allow us to breathe under water by delivering gas at exactly the same pressure as the water surrounding us. Each lungful of gas we inhale at depth, however, may contain several times more molecules than it would on the surface. This means that, the deeper we go, the faster we consume air. For example:

- At a depth of 10 m/33 ft, we will consume gas twice as fast as at the surface.
- At 20 m/66 ft, we will go through gas three times as fast.
- At 30 m/99 ft, our consumption will be four times what it was on the surface.

Among other things, this means that the deeper you go, the more frequently you need to monitor your pressure gauge.

The Impact of Increasing Pressure on Body Air Spaces

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *Which body air spaces are most affected by increasing pressure on descent?*
- *How can you equalize pressure in your middle ear spaces as you descend?*

Our bodies contain several air spaces, including the lungs, middle ears, sinuses and the passageways that connect them. As long as these passageways are healthy and open, the pressure inside these air spaces will equalize automatically during descent.

The exceptions are the middle ear spaces. The middle ears connect to the backs of our throats via the Eustachian tubes. These tubes are not sealed — but they are normally closed.

To allow the pressure in our middle ears to increase in direct proportion to the pressure in our other body air spaces and the water surrounding us, we must equalize this pressure manually. We can do so using any of a variety of methods:

- The most common method is the *valsalva maneuver.* To do this, you simply pinch off your nose, block your regulator mouthpiece and blow *gently.* As the air cannot escape through your nose or mouth, the only place left for it to travel is up your Eustachian tubes to your middle ears.
- Some divers can also equalize simply by yawning, swallowing or wiggling their jaws from side to side.

The key to equalization is to do it *early* and *often*. Begin at the surface. Pinch your nose, block your mouth and blow gently. The sensation you should feel inside your ears will confirm you are able to equalize and should be able to do so as you descend.

With practice, you will get a feel for how often you must equalize as you descend. To start, equalize *at least* once for every 1.0 m/3 ft of descent. More importantly, *you should never go deeper than you can comfortably equalize.*

If you reach a point in your descent where you can no longer comfortably equalize, *stop.* Ascend a short distance then attempt equalizing again.

- If successful, continue your descent, equalizing more frequently as you do.
- If you *cannot* equalize successfully in shallower water, continue ascending until you reach depth at which you *can* equalize successfully. Only then should you start back down again.

Do not attempt to equalize by exhaling forcefully. You could damage your ears. Instead ascend to a point where you *can* comfortably equalize.

It is important to understand that failure to equalize correctly can cause permanent ear damage resulting in loss of hearing and/or balance. Remember diving's *Rule Number Two:* Equalize *early* and *often*. Never go deeper than you can comfortably equalize. (In case you were wondering, we are working up to *Rule Number One.*)

The Impact of Decreasing Pressure on Body Air Spaces

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What happens to normal, healthy air spaces, such as the ears and sinuses, during ascent?*
- *What are the risks associated with diving with a cold or congestion?*

As you ascend, the gas inside your body's air spaces will expand. As long as your air passageways are normal, healthy and uncongested, air spaces such as your lungs and sinuses will vent this expanding gas automatically, each time you exhale. Even your middle ear spaces, which you most likely had to equalize manually on the way down, will generally depressurize by themselves.

Problems can arise, however, if you attempt to dive with a cold or congestion. Doing so may cause you to experience a *reverse block*, a situation in which expanding gas cannot escape the ears or sinuses. If you experience a reverse block:

- *Stop:* Continuing to ascend will only make matters worse.
- *Descend to a point at which the pain or discomfort subsides:* Wait here for several minutes to give the expanding gas the opportunity to escape. Yawning, swallowing or wiggling your jaw may allow gas trapped in the middle ears to escape.
- *Resume your ascent:* Ascend slowly and stop frequently to ensure expanding gas has the opportunity to work its way out.
- *Repeat this process as needed:* Do so until you can reach the surface without pain or discomfort.

Reverse blocks are rare but, sooner or later, most divers experience one. They are yet another reason it is important to keep plenty of breathing gas and time in reserve to deal with potential problems.

Drugs and Diving Don't Mix: Some divers take over-the-counter decongestants or other medications in an effort to make equalization easier. *Bad idea.* Decongestants can wear off under water, leading to a reverse block on ascent. *Any drug can have unforeseen side effects under pressure.*

Do not take over-the-counter medications when diving. If you are on any prescription medication, ask your doctor if it is safe to use under pressure. You should only dive when healthy and uncongested. Attempting to dive with a cold or congestion is just plain dumb.

Dealing With Vertigo on Ascent: Occasionally, air rushing out from inside the middle will cause the inner ear mechanism to cool, resulting in momentary vertigo. If this happens, stop. Find something to hold on to, such as a rock, ascent line or your buddy. If it helps to do so, close your eyes. The feeling will generally pass and you can continue your ascent. If it does not, have your buddy help you to the surface. Seek medical help if the situation does not improve.

Avoiding Lung Overpressure Injuries

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What happens to air in a flexible container during ascent?*
- *What is the most serious potential problem divers face and how can it be avoided?*
- *What should you be doing any time a regulator is out of your mouth?*

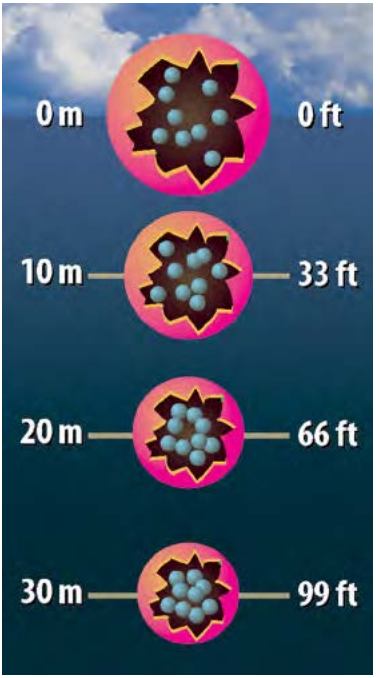
Gas expanding in your lungs during ascent normally vents itself through respiration. As long as you continue to breathe normally while ascending, you won't need to worry about this expanding gas. Serious problems can arise, however, if you attempt to ascend while holding your breath.

At depth, a lungful of air can easily contain many times more molecules than it would on the

surface. Were you to attempt to ascend while holding your breath, this air would expand and, having nowhere else to go, could rupture the *alveoli* or air sacs in your lungs, forcing air into your bloodstream. The air could also escape into your pleural cavity, collapsing a lung or putting pressure on other organs.

The risk of these *lung overpressure injuries* is greatest as you approach the surface. A serious lung overpressure injury can result from breath holding in as little as 1.2 m/4.0 ft of water.

Lung overpressure injuries are potentially fatal. They are the most serious injuries divers can suffer. They are also the most easily avoidable...which brings us to *Rule Number One* for scuba divers:



- *Breathe continuously* while on scuba; *never* hold your breath.
- If you cannot breathe normally (due, say, to air depletion or having a regulator out of your mouth), you can still breathe continuously by making a long, slow exhale. The best way to do so is to make an "Ahh" sound. This will help ensure that you are exhaling continuously while, at the same time, not exhaling too forcefully or too fast.

Your instructor will teach you to exhale a small, steady stream of bubbles any time the regulator is out of your mouth.

Rule Number One
Breathe Continuously
***Never* Hold Your Breath**

Other Barotraumas: There is another pressure-related injury that can result when a cavity or filling creates an air space inside a tooth. This can cause pain or discomfort on ascent or descent. If you experience pain in your teeth while diving see your dentist.

Breathing Under Water

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What may happen to the effort required to breathe at depth?*
- *What is the best way to breathe while using scuba?*
- *What is the best way to recover from overexertion under water?*

As you already know, the gas you breathe at depth will be denser than the air you breathe at the surface. The deeper you go, the more dense your breathing mixture will be.

As long as you breathe normally, you most likely won't notice any significant increase in breathing effort, down to the recommended recreational depth limit of 30 m/100 ft. If you start breathing hard, however, there is a possibility you may "over breathe" your regulator. That is, demand more air than the regulator is capable of delivering.

The best way to deal with this situation is to prevent it. You can do so by:

- Purchasing a regulator that can meet the demands of the diving you plan to do.
- Having your regulator professionally inspected and/or serviced at least once a year.
- Moving in a slow, relaxed manner under water and avoiding overexertion.
- Breathing efficiently.

The Most Efficient Way to Breathe Under Water: As you just read, breathing efficiently under water is important. It not only helps you make your breathing gas last longer, it can help prevent overbreathing your regulator.

The best way to breathe under water is *slowly* and *deeply*. This brings more air into your lungs, where your body can actually use it. Air that makes it no further into your body than your windpipe is effectively wasted. Slow breathing also reduces the likelihood of overtaxing your regulator.

Recovering From Overexertion: If you do find yourself starved for air under water, the first thing you need to do is *stop all activity.* If you can, find something to safely hold on to. Relax. Take slow deep breaths. The feeling should pass quickly. Then decide whether it is best to continue the dive or surface with your buddy.

Nitrogen Narcosis

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is nitrogen narcosis, what are its symptoms and at what depths do these symptoms generally become noticeable?*
- *What is the correct response to nitrogen narcosis?*
- *How can you help prevent nitrogen narcosis?*

Under pressure, the oxygen and nitrogen in the gas we breathe can impair judgement and coordination. Although, technically, some degree of impairment — however minute — occurs whenever the ambient pressure exceeds one atmosphere, its impact generally does not become noticeable or problematic until depths approach 30 m/100 ft.

We call this condition *nitrogen narcosis* — although recent studies suggest that the oxygen in air and Nitrox may be at least as narcotic as nitrogen. Susceptibility to nitrogen narcosis appears to vary from diver to diver, and from day to day. In other words, you may be fine at a certain depth one day and experience difficulty the next.

Symptoms of nitrogen narcosis include loss of coordination or motor skills, disorientation, bad judgement, euphoria or the sense that something just isn't right. If you experience these symptoms in yourself or your part-

ners, you and your team mates should immediately ascend to a shallower depth. Simply reducing the ambient pressure in this manner should ease the symptoms immediately.

You can avoid the symptoms of nitrogen narcosis by avoiding deeper dives. The recommended depth limit for recreational divers is 30 m/100 ft. This is due to a variety of factors, including the possibility of nitrogen narcosis, increased gas consumption and shorter no-decompression limits. Bear in mind, however, that simply staying above 30 m/100 ft will not make you immune to nitrogen narcosis. You need to be constantly vigilant and take appropriate action if you suspect its symptoms.

As a new diver, you should limit your depth to 20 m/66 ft, unless:

- You are under direct instructor or divemaster supervision.
- You have had advanced training that covers deeper diving.
- You have had the opportunity to gain experience at deeper depths slowly over time.

Decompression Sickness

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is decompression sickness (DCS), what are its causes and what primary factors put divers at risk of DCS?*
- *What additional factors can further increase the risk of DCS?*
- *What are the signs and symptoms of DCS?*
- *How do you respond to suspected DCS?*
- *How can you avoid DCS?*

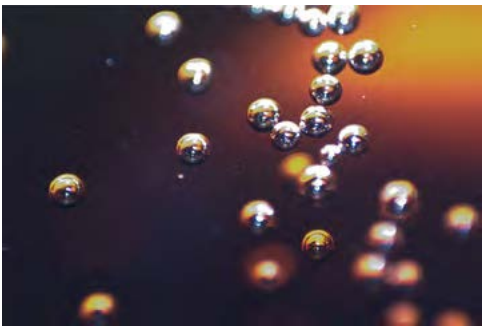
While our bodies metabolize the oxygen in the gas we breathe, they do little with the nitrogen other than absorb it into our bodies' tissues. How much excess nitrogen our bodies will absorb during a dive is a factor of depth and time. The deeper you go, or the longer you stay, the more nitrogen your body absorbs.

As soon as we begin ascending, this excess nitrogen will begin to come out of solution. If we keep the overall level of dissolved nitrogen within certain limits, and ascend slowly, we will "off gas" this nitrogen harmlessly through respiration.

If, on the other hand, we allow too much nitrogen to accumulate in our bodies' tissues, or we allow this nitrogen to come out of solution too quickly by exceeding safe ascent rates, tiny bubbles can form in our blood, joints and adjacent tissue. These bubbles can block the flow of blood and oxygen to vital organs and put pressure on nerve endings. The result is a very painful and debilitating condition known as *decompression sickness* or *DCS*.

The Signs and Symptoms of DCS: These can include:

- Pain, tingling and/or numbness — especially in the joints or extremities.
- Exhaustion or prolonged fatigue.
- Difficulty breathing.
- Dizziness.
- Paralysis.



The symptoms of DCS usually present themselves within an hour of surfacing — but can appear any time up to 12 or more hours later. Without proper treatment, DCS can cause permanent injury and, in extreme cases, death.

Lung overpressure injuries and certain other diving maladies may have very similar symptoms to DCS. It doesn't matter; the treatment is still the same.

First Aid for DCS: The immediate treatment for DCS is to have the patient lie down, drink plenty of fluids (preferably water) and to administer pure oxygen. Treat for shock or provide CPR as needed.

Oxygen administration is especially important and can bring a dramatic reduction in symptoms in just a matter of minutes. Administering oxygen requires special training; ask your instructor how you can get it.

If the symptoms appear serious enough to warrant medical treatment, you should waste no time in activating the Emergency Medical Service (EMS) system in your area. Regardless

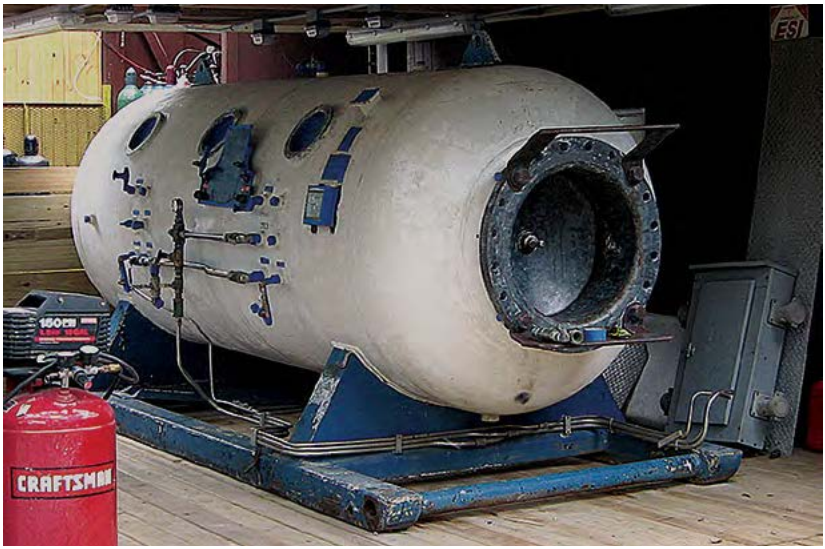
of the severity of symptoms, you need to call Divers Alert Network (DAN) at (919) 684-9111 as soon as you possibly can. If you need to activate EMS, DAN should be your very next call.

You can call DAN from anywhere in the world — although DAN primarily serves North America, the Caribbean, Bahamas and central Pacific. Many other parts of the world have their own regional equivalent of DAN whom you should call if available.

DAN (or its local equivalent) will connect you with an on-call physician who specializes in diving medicine and decompression sickness. The physician will help in assessing the situation and ensuring the proper steps are being taken. DAN can help coordinate with local EMS, emergency room physicians and the closest available recompression chamber.

DAN is a non-profit organization. It relies on member support to provide service to divers in need. You can join DAN at *www.diversalertnetwork.org*. The member benefits make it a worthwhile investment.

Treating DCS: While the steps outlined above constitute the appropriate *first aid* for DCS, *longer-term treatment* requires recompression in a hyperbaric chamber. As most health insurance policies don't cover this, supplemental divers' medical insurance is available through DAN and other organizations. *No diver should be without this important coverage.*



Preventing DCS: As with any diving emergency, the best way to deal with DCS is to prevent it. The primary way of doing so is to remain *well within* a set of depth and time limits known as the *no-decompression limits* or *NDLs*. You can obtain the NDLs for any combination of depth and time by using dive tables or — better still — following your dive computer. We will discuss this further later in the course.

Certain factors increase the risk of DCS. These include being overweight, injuries, illness, dehydration, fatigue, older age, cold, body dehydration, vigorous exercise before, during or after a dive. Alcohol consumption can also contribute to the onset of DCS. If any of these factors are present, you should stay even further within the no-decompression limits or simply not dive at all.

As dehydration can be a major contributing factor to DCS, always remain well hydrated while diving. Drink plenty of water, but avoid caffeinated or alcoholic beverages, as they will actually make matters worse.

Among the most important things you can do to help prevent DCS is to ascend slowly from every dive. Your ascent rate should never exceed 10 m/33 ft per minute (which is a lot slower than it sounds). Your dive computer may require you to ascend even slower than this — especially as you approach the surface.

You should also end all but the shallowest of dives with a precautionary decompression or "safety" stop for three to five minutes at 3-6 m/10-20 feet. You can spend this time hanging on to an ascent line or simply swimming around in very shallow water.

Oxygen Toxicity

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is oxygen toxicity and what risk does it pose to divers?*
- *What gas mixtures do recreational divers normally breathe, and to what depths can these gasses be used without incurring the risk of oxygen toxicity?*
- *How can you manage the risks associated with oxygen toxicity?*

A common misconception is that divers breathe from tanks containing pure oxygen. In reality, divers primarily breathe from tanks containing nothing more than the same air you are breathing right now — air that contains just 21 percent oxygen.

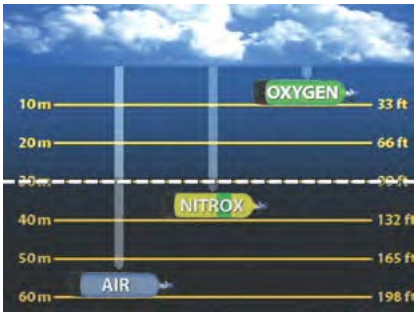
In fact, the only divers who *ever* use pure oxygen are technical divers, who use it as a decompression gas, and military special ops divers, who use it in rebreathers. What these applications have in common are:

- They require highly specialized training and equipment.
- They are limited to *very* shallow water — typically no more than 6 m/20 ft.

The reason is that, under pressure, oxygen in high concentrations can be toxic. A diver suffering from *oxygen toxicity* can lose motor control and begin convulsing. While this is not necessarily fatal above water, under water it could cause divers to lose mouthpiece and airway control and drown.

The oxygen found in air does not pose a risk to divers until they reach a depth of 57 m/188 ft — well below the recommended recreational depth limit of 30 m/100 ft. Divers with special training may also breathe Enriched Air Nitrox (EANx), a gas mixture with a higher concentration of oxygen than that normally found in air.

The most common EANx mixture contains 32 percent oxygen. This has a *Maximum Operating Depth* or *MOD*, based on oxygen exposure limits, of 34 m/111 ft — still comfortably beyond the recreational depth limit. In contrast, the MOD for pure oxygen is 6 m/20 ft. Beyond this, the risk of oxygen toxicity is very real.



The course you are taking right now will prepare you to dive normal atmospheric air. With a little additional training, you can also dive using Nitrox mixtures with oxygen concentrations of up to 40 percent. This can result in longer bottom times, shorter surface intervals and greater safety margins.

Nitrox diver training should be the very next course you take (in fact, some instructors have their beginning students take it in conjunction with this course). Nitrox diver training requires little more than self study and the only prerequisite is that you be a certified diver.

What you *should not* be doing is filling your tanks with pure oxygen. Doing so can be *extremely dangerous* and is best left to those with the specialized training and equipment needed.

Carbon Monoxide Poisoning

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is carbon monoxide poisoning?*
- *What circumstances could cause divers to experience carbon monoxide poisoning?*
- *What two factors influence the severity of carbon monoxide poisoning?*
- *What other factors may affect the quality of the gas we breathe?*
- *How can you prevent or respond to problems with your breathing gas?*

You most likely know that, in sufficient concentrations, *carbon monoxide* (CO) is poisonous. By blocking our cells' ability to use oxygen, carbon monoxide can literally suffocate us while we appear to breathe normally.

Carbon monoxide generally results from engine exhaust — although CO itself is odorless and tasteless. If a compressor intake were located too close to

a source of exhaust fumes, carbon monoxide could get into dive tanks and be difficult to detect.

Our bodies' susceptibility to carbon monoxide depends not only on the concentration of CO in our breathing gas, but also on the depth. A CO concentration that would cause little problem in shallow water could be fatal under several atmospheres of pressure. The symptoms of CO poisoning include headache, vertigo and a feeling that "something just isn't right."

Yet another problem may result if a faulty filtration system or other malfunction causes compressor lubricant or other contaminates to get into our breathing gas. This poses a serious health risk. Fortunately, this sort of problem generally does result in a detectable odor or taste.

One of diving's cardinal rules is that *any* team member can terminate *any* dive, at *any* time and for *any* reason. If you suspect a problem with your breathing gas, or that of your team mates, end the dive and ascend immediately. Do not dive again until your gas can be analyzed.

Clearly, the best way to deal with this sort of problem is to prevent it.

- When assembling your scuba unit, test breathe the regulator, checking for the presence of odor or taste.
- Get your tanks filled only at a professional dive center or resort.
- If a gas- or diesel-powered compressor is in use, inspect the system for adequate separation between the compressor intake and engine exhaust.

It is a standard of practice among dive centers and resorts to have their breathing air tested for quality on a regular basis. The resulting certificate is generally posted near the air station. Look for it.

Shallow Water Blackout

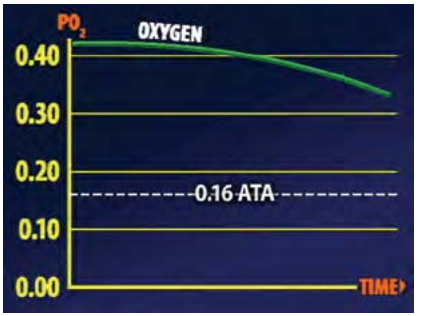
What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is shallow water blackout?*
- *How can breath-hold divers avoid shallow water blackout?*

Some of the world's best divers *don't* use tanks. Breath-hold or *free diving* gives us the ability to dive when using scuba isn't practical and is an art form in and of itself.

Free diving, however, entails a risk that is not present when using scuba. This is *shallow water blackout*. To understand shallow water blackout, you need to know a little bit about the concept of partial pressures.



A partial pressure is a value obtained by multiplying the percentage of a gas present in a mixture by the depth in atmospheres. For example, air contains 21 percent oxygen. At a depth of two atmospheres, its partial pressure would be twice this, or 0.42 ATA.

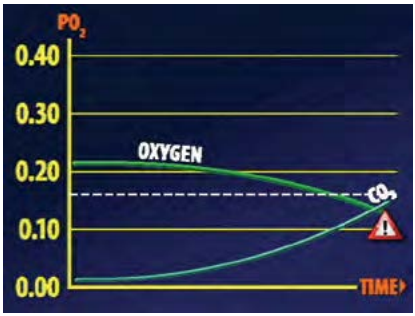
The human body needs a partial pressure of 0.16 ATA to maintain consciousness. Now let's say a free diver managed to stay down long enough so that the concentration of oxygen in his lungs dropped to 14 percent.

- At a depth of two atmospheres, this would yield a partial pressure of 0.28 ATA — more than sufficient to maintain consciousness.
- As the diver ascends, however, the partial pressure would drop, ultimately reaching 0.14 ATA as the diver approached the surface.

This means the diver could lose consciousness as he ascends. Shallow water blackout generally occurs around 3-5 m/10-15 ft. How could a diver manage to hold his breath so long as to risk shallow water blackout?

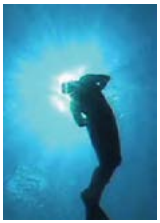
- Our stimulus to breathe comes not from the diminishing level of oxygen in our systems, but rather from the rising levels of CO_2.

- On a normal breath-hold dive, the desire to breathe comes well before there is any risk of passing out on ascent.
- Some divers, however, will *hyperventilate* prior to a breath-hold dive. This entails taking several long, deep inhalations and exhalations, in an effort to lower the body's starting CO_2 levels, so that the stimulus to breathe comes later.
- The problem is, in so doing, divers may cause the stimulus to breathe to come *too late*, and risk passing out on ascent.



To free dive as safely as possible, do the following:

- *Always wear a wet suit:* This provides buoyancy at the surface that does not have to be orally inflated following a breath-hold dive (which is not a good idea when your CO_2 levels are already high).
- *Weight for neutral buoyancy at 5 m/15 ft:* Yes, you will have to kick a little to get down; however, if you were to pass out on the way up, you'd most likely float the rest of the way to the surface, where it would be easier for a buddy to assist you.
- *Don't hyperventilate more than one or two breaths:* Any more than this just puts you at risk of shallow-water blackout.
- *Don't ignore your first strong urge to breathe:* Yes, your body *is* telling you something.
- *Always have a buddy spot for you:* Practice the *one up/one down* approach to free diving. This way, if you get into trouble, your buddy is ready to come to your aid.



Just because you are learning to scuba dive, don't overlook the fun and excitement free diving offers. Just do it smart and safe.

Congratulations…

You've completed Unit One. Don't forget to go back and complete the Study Questions for this unit before proceeding to Unit Two.

Unit Two

The Aquatic Environment

Water covers nearly three quarters of the planet, yet what goes on beneath it is less familiar than the surface of the moon. In this section, we look at the forces that affect us while in this environment, as well as the plants and animals which inhabit it.

No Two Sites the Same

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are some of the ways in which dive sites can differ from one another?*
- *How can you prepare yourself for diving in an unfamiliar environment?*
- *What is one of the best ways to gain an introduction to a new diving environment?*

Every dive site is different. Ways in which dive sites may differ from one another include:

- Climate.
- Local weather.
- Salinity.
- Water temperature.
- Bottom composition.
- Aquatic life.
- Currents.

Travel can take you to dive sites that are vastly different from those you experience at home. Any time you dive an unfamiliar site, you want to arm yourself with as much information as possible. Dive boat crews can provide a wealth of such information, which helps explain why boat diving is so popular at dive destinations.

If you don't have the luxury of a boat crew to guide you, you can also obtain information from:

- Local dive centers.
- Guidebooks.
- Other divers.
- The Internet.

Some dive sites require the use of special techniques, or equipment with which you may not be familiar. Among the best ways to learn about these is by taking part in an Advanced or Specialty Diver course, participating in an organized dive activity, or engaging the services of a local divemaster or instructor to show you the ropes.

Water Temperature

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What factors can affect water temperature at any location?*
- *What do you call the boundary between water layers of different temperatures?*
- *On what should you base your decision as to what kind of exposure protection to wear?*

Seawater temperatures range from -2° C/28° F to 36° C/96° F. In a given area, water temperatures usually vary less than 8° C/15° F to 11° C/20° F throughout the year.

In addition to changes caused by season and climate, water temperatures also change with depth, usually getting colder as you descend. While descending, you may encounter a temperature change. This point of change is called a *thermocline*. The temperature at the thermocline may vary as much as 8-11° C/15-20° F.

While preparing for a dive, you need to consider the water temperature at the depth you are going to. If you are unsure what the water temperature may be, ask a local dive center. Knowing the water temperature will help you decide what type of exposure protection to use.

Diving in extremely cold or icy conditions requires proper exposure protection and special training. Your instructor and dive center have specialty courses that can provide you with the training you need for cold water or ice diving.

Bottom Composition

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What does the term* bottom composition *refer to?*
- *What are the four most common types of bottom composition?*

During a dive you will spend most of the time near the bottom. There are several bottom compositions that will affect you: silt, mud, vegetation, rock, coral, and sand. The best bottoms for diving are rock, coral and vegetation. Most fresh water bottom compositions consist of silt, mud and sediment.

Some bottom compositions may require you to take precautions while moving around under water. Muddy bottoms are stirred up very easily. If this occurs, your visibility will be greatly diminished by sediment and sand suspended in the water. Also, if you drop anything, it may settle into the mud. Entanglement in submerged objects, trees, brush or

aquatic plants is possible if you are not cautious. Coral and rock bottoms can damage to your equipment if dragged.

Diving Around Coral

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *Why is extreme care required around coral?*
- *What is the most important skill divers must practice around coral?*

Coral reefs pose a unique set of challenges. A coral reef system is very delicate, made up of many aquatic organisms, and even a gentle touch could kill thousands of these organisms. You must be very cautious when exploring. Minimize your contact, not only for the safety of the reef, but for your safety as well.

There are animals that live in the reef that can cause injury to you by stings or bites. An unsuspecting diver could sit on, kneel on, or otherwise come in contact with one or more of these animals. Always be aware of your surroundings and use good buoyancy control to minimize any injuries to yourself or to the aquatic life that lives there.

As you learned in Unit One, maintaining neutral buoyancy will help you avoid coming into contact with the bottom inadvertently with your

fins. Secure all hoses, bags, cameras and any items that are dangling. These precautions will help to ensure that your dive will be more enjoyable and help prevent damage to the marine environment.

Visibility

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What factors are most likely to affect visibility?*
- *What is the biggest challenge associated with diving in poor visibility?*
- *What should you consider doing in extremely poor visibility?*

Underwater visibility is defined as the distance you can see in a horizontal direction underwater. Visibility can range up to 30 m/100 ft or more. Underwater visibility is affected by these factors:

- Suspended particles.
- Weather.
- Bottom composition.
- Water movement (waves, surf, and currents).

Waves, surf and currents churn up the sediment and suspend particles in the water. Sometimes microscopic plants (algae) and animals (plankton) proliferate until they cloud the water. The kick of a diver's fin, the wake of a boat, or rain runoff can also churn up particles from the bottom.

In limited visibility it is difficult to keep track of your buddy and your location. During an ascent or descent in these conditions, it is possible to become disoriented and you may not know which way is up or down.

When diving in limited visibility, stay close to your buddy. If necessary, hold onto your buddy's console, tank valve, or hand. Use your compass to keep track of your direction and a timepiece to track the distance you have swum. If the visibility is extremely poor, cancel or postpone your dive until conditions improve, or choose an alternate site.

Diving in Extremely Clear Water

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is the primary challenge associated with diving in extremely clear water?*
- *What piece of diving equipment will make diving in extremely clear water easier?*

Diving in extremely clear water may seem easy, but there are some problems to consider. Judging distance and the depth of the water is difficult in clear water. The bottom will appear to be closer than it actually is because of water's magnifying effect.

During a descent, refer to your computer or depth gauge often to keep from accidentally exceeding depth limits. Vertigo can occur during ascents and descents in extremely clear water with a lack of references. Use an ascent/descent line when possible. An ascent/descent line is a rope, chain, or cable running from the surface to the bottom. It can be suspended at the surface by a float and anchored to the bottom by a weight, or fastened to an object on the bottom. Its purpose is to provide you with a tangible reference during ascents and descents in both poor visibility and very clear water. It also provides something to hold onto while performing a safety stops (you will learn about this later).

Aquatic Life Interaction

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is the general rule divers should follow in the presence of aquatic animals?*
- *What are the most common aquatic animal injuries and what is their underlying cause?*
- *How can you prevent most aquatic animal injuries?*

As a diver, you get to interact with animals most people don't even know exist. Remember that you are a guest in this environment. The impact you have on a dive site depends, to a large degree, on your interaction with its life.

Aquatic animals are sensitive to their surroundings. Quick, jerky movement may be considered aggressive; slow and deliberate movement is less likely to disturb them. Slow and smooth movement will also reward you with more opportunities to observe the natural behavior of aquatic life and avoid disruption of their habitat.

Physical contact with aquatic life can be detrimental. Corals, for example, are made up of thousands of microorganisms; even a gentle touch of a hand can damage coral in ways that may take years to repair. It is your responsibility to minimize your impact on this type of aquatic life.

Most aquatic animals are timid and harmless. Some are as fascinated with you as you are with them. Most aquatic life injuries are simple cuts, scrapes and punctures, resulting from divers not paying attention to their surroundings. Other injuries result from cases of mistaken identity or defensive

behavior — not from animals that are naturally aggressive or who have any desire to eat humans.

Making yourself familiar with the aquatic life present at your dive site will help you avoid injuries. Be aware of your surroundings; watch what you touch. Wearing an exposure suit will help protect you from accidental contact with stinging corals and scrapes against barnacles.

Some animals can be dangerous when provoked; however, diver injuries caused by aquatic animals are extremely rare. Some animals, such as sharks and moray eels, have undeserved reputations. This is a result of our overactive imagination.

If you see a large animal acting in a seemingly aggressive manner, remain calm, descend to the bottom if possible, and maintain eye contact. More than likely, the animal is just passing through. If it stays in the area, slowly swim away near the bottom and exit the water at the first opportunity.

Injuries from moray eels result from making the animal feel threatened. Moray eels are very territorial and act defensively. If you accidentally or irresponsibly stick your hand in an eel's lair you may be bitten.

To avoid potential problems: treat all animals with respect, watch where you are going and watch the placement of your hands and fins. Establish neutral buoyancy; wear a proper exposure suit and other protective gear; avoid wearing shiny jewelry; remove speared fish from the water as soon as possible; and avoid contact with any unfamiliar animals.

Aquatic Plants

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What role do plants play in the aquatic environment?*
- *What risk do aquatic plants pose to divers and how can you minimize this risk?*

Aquatic plants range from giant kelp forests to smaller grasses and algae. Plants provide food and shelter for aquatic life. A concern that divers may have with plants is the possibility of entanglement. This is not a serious

problem. With a little training and experience, and keeping all equipment attached and streamlined, you will find that maneuvering through plants can be done with ease.

In the event you do get entangled, stop, remain calm, do not struggle or fight. This may cause the problem to become worse. Calm yourself and then evaluate the problem. Work slowly to free yourself, and if possible, have your buddy assist you.

Water Movement

Water movement can have a significant impact on when, where and how you dive. There are many kinds of water movement, including currents, waves, surf, surge and tides.

Currents

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are the four main causes of ocean currents?*
- *Why should you never attempt to fight a current?*
- *What three general rules apply to diving in currents?*

A current is a mass of water moving in the same direction. Currents occur in most bodies of water to some extent. Four main causes of currents are:

- Winds blowing over the surface of the water.
- Cooling and heating.
- Tidal movements.
- Waves.

When diving in a current, you need special techniques to avoid exhaustion. Trying to swim against even a gentle current can quickly tire you out. As you swim against a current, you will use your air supply faster and you will work harder.

If a mild current is present at the dive site, begin your dive against the current. At the end of your dive, you can use the current to assist your return to the boat or shore.

If you find it necessary to swim against a current you will find it easier to swim near the bottom because the current is usually weaker there than at the surface. Any time you find yourself at the surface and the current carries you past the exit point, swim perpendicular to the current and toward the exit point. By doing this you will find it easier to swim out of it. Then you can swim back to your exit point.

Do not overexert. If you become tired, first make sure that you are positively buoyant, signal the shore or boat for help, and wait for assistance.

Rivers are currents. Scuba diving in a river requires special training. You can receive this training from dive centers in the area where these conditions are common.

Waves and Surf

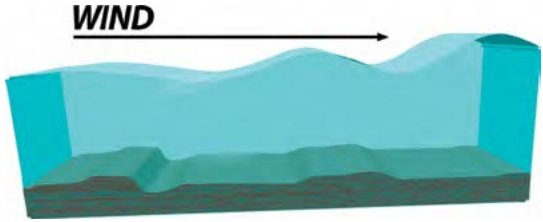
What to Look For

As you read through this section, highlight or underline the answers to the following:

- *How are waves formed?*
- *What determines the size of waves?*
- *What causes surf?*
- *What are wave sets and how may they affect your entries and exits?*
- *What is undertow and how may it affect divers?*

Except for major ocean currents, most water currents that concern you as an ocean diver are a result of wave action. Waves are formed when wind blows over the surface of the ocean. The size of a wave relates directly to the duration and strength of the wind. Waves can travel for thousands of miles until they finally break in shallow water.

A wave travels along the surface until it encounters shallow water. Contact with the ocean floor causes the lower portion of the wave to slow down as it drags along the bottom. The upper portion of the wave will overtake the lower portion causing the top of the wave to fall forward and break as *surf*.



A wave will break in water that is slightly deeper than its height. Anything that creates this condition like an offshore reef, shipwreck, or sand bar will cause a wave to break. These waves may re-form as they continue toward the shore and break again. The area in which waves break is called the *surf zone*. Beach entries and exits can be difficult in these surf zones. Avoid diving when the surf is large and rough. You need specialized training to enter and exit the surf safely. You will be wise to stay out of the surf until you have had this training.

Sometimes waves approach the shore at different angles, causing the waves to reinforce or nullify one another. This creates wave *sets*. Wave sets are a series of small waves followed by a series of larger waves.

After a wave breaks on the shore, it flows back into the ocean under the incoming wave. This back flow of water is called *undertow*. As the undertow flows back into the ocean it dissipates at a depth no greater than 1 m/3 ft. An undertow is not a current that will pull an object out to sea. Sometimes, though, the back flow of water can be quite strong, making it difficult to keep your balance during any entries into or exits from the water.

Surge

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is surge?*
- *What risks are associated with diving in surge?*
- *How can you avoid surge?*

When diving in shallow water with waves passing overhead, you may feel a back-and-forth movement. This motion is called *surge*. The larger the waves over head, the larger the back-and-forth motion or surge.

A strong surge can be very dangerous, but can be avoided by swimming to deeper water. Surge can also be helpful. If you hold on to an immovable object while the surge is against your direction of travel, and then let go when it is moving with your direction of travel, it can help you along.

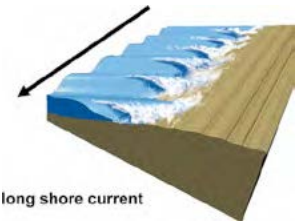
Longshore Currents

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are longshore currents and what causes them?*
- *What strategies can divers follow when diving in longshore currents?*
- *What should you do if caught downcurrent from your intended exit point?*

A longshore current is caused by waves approaching the shore at a slight angle. While diving in a longshore current, the movement of water can move you parallel to the shore and away from your exit area.



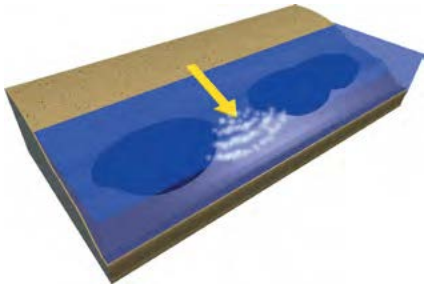
Plan your dive so that the entry point is up current from your exit point, or dive into the current so that you can drift back to your exit point. If caught in a long shore current do not tire yourself by swimming against the flow of water. You may be able to exit it by swimming at a right angle to the current while swimming toward shore.

Rip Currents

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are rip currents?*
- *What should you do if caught in a rip current?*



Rip currents occur when water piled up on shore by wave action funnels back to sea through a narrow opening in a reef or sand bar. As a rip current rushes seaward, a line of turbid, foamy water interrupts the normal wave pattern.

Rip currents can be very strong, and an unaware diver may be carried away from shore very quickly. Any time you get caught in a rip current, establish buoyancy, turn and swim parallel to shore until you clear the rip area.

Upwellings

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are upwellings?*
- *How can upwellings affect divers?*

When winds blow offshore, they push warm surface water away from shore. As the surface water moves out, deep water flows upward and replaces the warm water. This is called an *upwelling*. The deep water is usually cold and clear. Sometimes this creates excellent diving conditions.

Tides

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What causes tides?*
- *How can tides affect divers?*

Coastal regions have a rhythmic rise and fall of water levels called *tides*. Tides are caused by the gravitational pull of the sun and moon on the ocean. Tides vary in height and time due to geographic configuration. Tides affect diving conditions by producing currents and by changing visibility and water depths. Best diving conditions can occur during high tide. Consult a local dive shop for information on tides if they are likely to be a factor.

Congratulations...

You've completed Unit Two. Don't forget to go back and complete the Study Questions for this unit before proceeding to Unit Three.

Unit Three

Now that you understand the basic science behind diving and are more familiar with the aquatic environment, it's time to talk about the equipment you need to explore this environment safely.

The Most of Personal Dive Equipment

Comfort and fit is essential for all dive equipment. For some items, however, it is so important that you would be foolish to borrow or rent these items. The items most experts feel every diver needs to own includes masks, fins and snorkels.

Dive Masks

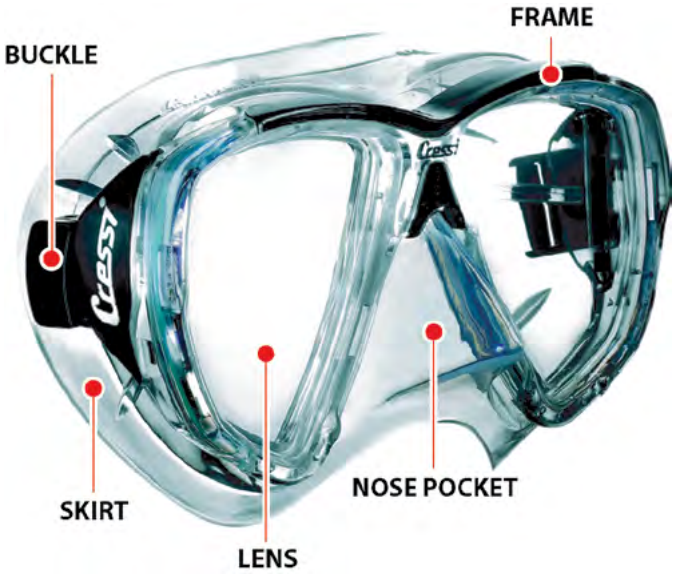
What to Look For

As you read through this section, highlight or underline the answers to the following:

- *Why do divers need to wear dive masks to see under water?*
- *What are several common features of modern dive masks?*
- *What are the two most important features when selecting a dive mask?*
- *What steps do you need to take to prepare your dive mask for use?*
- *What steps do you need to take between dives to protect and care for your mask?*

As you read earlier, masks allow us to see under water by creating an air space in front of our eyes. Dive masks typically incorporate a number of features, including:

- *Tempered glass lenses:* These help resist breakage but, if broken, will crumble into less potentially harmful pieces.
- *Frame:* Attaches and holds the lenses, skirt and strap assembly to one another.
- *Nose pocket:* Facilitates equalization. It's important that the mask cover the nose (swim goggles *will not* work), so that you can keep pressure inside the mask equal to ambient pressure just by exhaling into it.



- *Skirt:* Typically clear silicone; however, some divers prefer black. A feathered edge helps make a good seal; a second, separate inner skirt further improves this seal.
- *Strap:* Generally made from the same silicone as the skirt. A wider section in back helps ensure a more secure fit around the back of the head.
- *Adjustable buckles:* Enable wearers to quickly adjust the strap for the best fit.

Many divers replace the stock silicone mask strap with a neoprene foam comfort strap or strap cover that tends to pull less on hair. Additional important features include a low internal volume and a wide field of vision. Modern masks generally achieve this by having a wide lens or lenses that fit close to the face.

If you need glasses to drive or read, you need "glasses" to dive. You can wear gas-permeable contacts underneath your mask (although there is a slight risk of losing them). Your dive center can tell you about options for having lenses with your exact prescription installed in your mask.

By far the two most important mask features are *comfort* and *fit*. This is why it is important to have a qualified dive professional help you when selecting a mask.

Preparing Your Mask for Use: During the manufacturing process, mask lenses become coated with the *releasing agent* used to remove the mask skirt from its mold. You need to remove this chemical prior to use or you *will not* be able to successfully defog your mask. Special cleansers are available for this purpose from your dive store; otherwise, scrub the mask lens *thoroughly* with a non-abrasive cleanser.

Before each use, you will need to apply chemical defog to the inside of your mask lens. This is best done *before* the mask gets wet. Follow the instructions on the defog for proper use.

Caring for Your Mask Between Dives: As with all dive equipment, you should rinse your mask in fresh water after use in salt water. Allow your mask to dry thoroughly, then store and transport it out of direct sunlight, in a protective case.

Scuba Fins

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What type of fins are most appropriate for use by scuba divers?*
- *What are several desirable scuba fin features?*

Scuba fins allow you to move through the water with maximum efficiency and minimal effort. Snorkelers and scuba divers use two, very distinct types of fins.

If you've ever been snorkeling, you are most likely familiar with a style of fin called a *full foot fin*, as the pocket encloses your entire foot. Full-foot fins are well suited for the casual snorkeler. They're easy to kick, without special training, and tend not to break the surface on the up stroke. Full-foot fins have some serious limitations, however, that make most such fins poorly suited for scuba diving.

- In so far as they are designed to be worn over bare feet, full-foot fins *cannot* be used comfortably in cold water.
- Divers who try to use full-foot fins to scuba dive might be forced to walk barefoot over rocks, gravel, coral and other unforgiving surfaces on their way to and from the water.
- Most importantly, all but the very best quality full-foot fins lack sufficient power to overcome the added drag of scuba equipment, or to deal with the stronger currents and more challenging conditions scuba divers sometimes encounter.

You will occasionally see dive guides and other experienced divers use extremely good quality full-foot fins while diving from smooth boat decks in warm water. You can pretty much bet, however, that these will not be the only fins these divers own.

As it is likely that, initially, you will own just one pair of fins, it makes sense to invest in the right kind for scuba diving. These are called *open-heel* or *adjustable* fins. Adjustable fins offer scuba divers several important benefits.

- To start, they're designed to be worn over wetsuit or drysuit boots, which means that divers' feet are not only protected in colder water, the divers can also walk to and from the water over rough surfaces with less risk of injury.
- More importantly, as this type of fin is designed specifically for scuba diving, adjustable fins provide divers with the power and strength they need.

Adjustable fins consist of a heel strap, foot pocket and blade.

- The stock heel strap on most fins is adjustable on both sides and incorporates quick release buckles for easy removal.

- Some higher-end fins come with spring heel straps, which make the process of donning and removing fins extremely easy. These are also available as an after-market upgrade for most fins.
- The foot pocket needs to be large enough to fit over wet suit or dry suit boots. When buying fins, select your boots first, then try the fins on over them.

The most basic adjustable fins will have a simple, flat blade. These are sometimes known as *paddle fins*. Better quality fins will usually incorporate some sort of *blade enhancement technology*, designed to increase power and efficiency, while reducing the effort required to kick.

Common blade enhancement technologies include vents that reduce drag, flexible panels that cup the water, and hinged surfaces that reduce drag on the down stroke, while snapping back to full efficiency on the up stroke.

Among the most popular blade enhancement technologies is the split fin. These fins have blades that not only help reduce drag in both directions, they allow more of the surface area of the blade to form an oblique angle on both the up and down strokes.

Selecting the right fins involves achieving the correct balance between power and efficiency. While you don't want fins that lack sufficient power, you also don't want fins that are difficult for *you* to kick. You also need fins that fit you correctly. This is why it is important to seek out the advice of a qualified dive professional when buying fins.

Snorkels

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *Under what circumstances might scuba divers want to use snorkels?*
- *What are some common snorkel features?*
- *How do you attach and position a snorkel on your mask?*

Divers typically *do not* spend a lot of time on the surface. As a general rule, you want to *avoid swimming on the surface whenever possible*. At times, however, you don't have a choice.

Most divers, when swimming on the surface, choose to do so on their backs, with their BCs at least partially inflated. Doing so allows divers to keep their heads out of water, where they can breathe through their nose and mouth, and see and talk to buddies.

Occasionally, however, divers need to be able to swim *face down*, so that they can monitor what is going on below them or make certain they have arrived at the right place to descend. Under these circumstance, having a snorkel allows divers to do so down while conserving the air in their tanks.

Modern snorkels incorporate a number of features, including:

- A curved barrel that fits close to the head.
- A flexible lower section that drops away when not in use.
- A purge valve, located beneath the mouthpiece, that allows the upper portion of the snorkel to self-drain when it is out of the water.
- An attachment mechanism or "keeper" that enables wearers to attach the snorkel to the mask strap.

Many snorkels will have a baffle or deflector at the top to minimize the amount of water that gets inside the barrel. Some snorkels even have a dry valve that prevents water from entering all together.

When attaching a snorkel to your mask, place it on the left-hand side and slightly back. This way, it will not interfere with your regulator and will tend to point straight up when you are looking down.

In most situations, where there is little need for snorkels, most experienced divers choose *not* to wear one. Snorkels can cause unwanted drag in strong currents. They also force divers to wear their mask straps *outside* their hoods, which can interfere with the mask's ability to make a good seal.

Still, some divers feel it is better to have a snorkel and not need one, than to need one and not have it. A good compromise in these situations is to carry a folding snorkel that stows in a BC or wetsuit pocket. This way, the snorkel does not get in the way, but is there if you need it.

A snorkel is something every diver should own and know how to use — even if most of us seldom really need one while scuba diving. After all, if you don't own a snorkel, how are you going to go snorkeling between scuba dives?

The Scuba Unit

Your scuba unit is comprised of your BC, scuba tank, regulator system and gauges. In so far as your weights are generally integrated into your BC, we will talk about your weight system in this section as well.

BCs

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What key components may a BC have?*
- *What are the two primary styles of recreational BCs?*
- *What factors should you consider when purchasing a BC?*

The acronym *BC* originally stood for *buoyancy compensator*, back when these devices were little more than inflatable horse-collar vests that could only be used to help compensate for loss of buoyancy due to wetsuit compression and provide a modicum of surface flotation. Today's BCs perform a variety of important functions.

- The *harness* enables the BC to attach your tanks and regulators to your body.
- The BC's *air cell* not only allows you to compensate for loss of buoyancy at depth, it can also help you rest or swim at the surface with your head out of the water.
- The air cell will generally have a *large-diameter inflation/deflation hose* or *airway*, attached near the top of the air cell and ending in a power inflator assembly.
- The *power inflator* allows you to inflate your air cell with air from your scuba tank at the push of a button. A second button lets you inflate the air

cell orally, or deflate the air cell by pressing and holding the button while keeping the mouthpiece as high as possible.

- Virtually all BCs provide divers with *alternate means of venting air from the air cell*. The most common is an exhaust valve located at the top of the airway that is activated by simply pulling down on the airway itself.
- Many BCs also have *manual dump valves* at the shoulder or back of the BC, activated by pulling on a cord.
- Some divers equip their BCs with an *alternate air source inflator*, in place of the standard low-pressure inflator. These combine the functions of a BC inflator with those of an alternate air source second stage. We'll discuss alternate air sources in greater depth in a later section.

- Modern BCs come with a variety of *D-rings* to which you can attach alternate air source second stages, instrument consoles and other equipment. These are important, as you never want to allow this equipment to dangle freely, where it could be difficult to find or cause damage to the bottom.
- The vast majority of BCs sold in the past two decades have come with *integrated weight systems*. These are typically pockets with quick-release mechanisms that allow divers to quickly drop some or all of their weight in an emergency. We'll discuss weight systems in more detail, later on in the course.
- Most BCs come with *storage pockets*. These are handy for keeping all sorts of items, like gloves, slates and signaling devices.

Modern recreational BCs generally fall into one of two types.

- *Jacket-style BCs* have air cells that partially surround the diver, and are an integral part of the harness assembly.
- As the name implies, *back-inflation BCs* have air cells that are largely separate from the harness and reside *behind* the wearer.

The best BC for you will depend not only on comfort and fit, but also on the type of diving you do. For example, if you do a lot of travel to warm-water dive destinations, you don't want a big, heavy BC that consumes half your baggage allowance. On the other hand, if you anticipate one day getting into technical diving, you want a BC that will grow with you.

As always, your instructor will be one of your best sources of advice when finding the BC that best meets your needs.

Weight Systems

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are the two primary types of weight systems used by recreational divers?*
- *What advantages do integrated weight systems offer over conventional weight belts?*
- *What is the best way to determine precisely how much weight you need?*

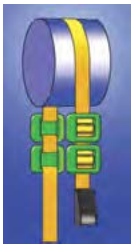
As you learned earlier, divers generally need lead weight to offset their bodies' natural buoyancy, and that of certain equipment items, such as wetsuits. In the last segment, you learned that nearly all of the BCs sold in the past two decades have incorporated an integral quick-release weight system for carrying that lead.

> If you don't own your own BC, however, this is a technology you most likely *won't* have access to. Why? *Most rental and teaching BCs do not presently incorporate weight integration.*

So, if you can't put your lead inside your BC's weight system, where does it go? The answer is on a conventional weight belt — a technology that has been part of diving since its very inception.

The simplest weight belts are little more than 5 cm/2 in wide pieces of nylon webbing, with a quick-release buckle on one end. You string these belts with the right amount of solid lead weight — what are known as *block* or *bullet* weights. Plastic or metal slides can help hold the weight in place.

Another popular type of weight belt incorporates individual pockets for the weights. You can use these weight belts with solid weights, or with bean-bag style soft weights, which many divers find more comfortable. Soft weights also work well with weight-integrated BCs.



Part of the trick to using weight belts is setting them up correctly. You need to distribute the weight evenly on each side — and leave a space in the back so that you don't get any weight caught between you and your tank.

Placing the weight somewhat forward also helps ensure that the belt will drape nicely across your back. This helps when donning weight belts on the surface and, more importantly, helps prevent a dangerous situation that could result when back-mounted weights swing around to the front, putting the quick-release buckle in a place where divers can't get to it.

As much as possible, weight belts should not be covered up by other equipment. This can be a bit of a challenge when using a weight belt with a jacket-style BC.

Most divers prefer BC-integrated weight systems because they are significantly more comfortable and a lot more convenient. There are other considerations as well.

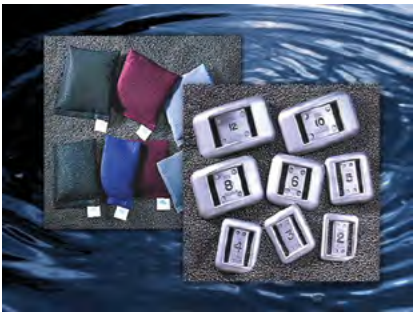
- It can require several more steps to successfully drop a weight belt in an emergency than it does to drop an integrated weight system pocket.
- Weight belts generally do not give you the option to drop just *some* of your weight, the way weight-integrated BCs typically do. This means that, if you have to drop your weight at depth, it will be very difficult to keep your ascent rate under control.
- Weight-integrated BCs tend to keep your weight more in line with your body's natural balance point. This makes it easier to maintain the near-horizontal body position that not only makes divers more streamlined, it helps keep their fins away from the bottom.

Clearly, if you want to avoid the concerns associated with using weight belts, you need to invest in your own personal BC and take it with you everywhere you dive.

Nevertheless, even if you own your own weight-integrated BC, it's a good idea to take a conventional weight belt with you on dive trips. This way, should you accidentally lose a weight pocket, you can continue diving by switching your weight to the belt.

How much weight should you wear? This will be affected by factors such as your body's natural tendency to float or sink, whether you are diving in fresh or salt water, and the thickness of your exposure suit.

> *There is no magic formula that can give you any more than the roughest estimate of how much weight to use.* To find out the precise amount of weight you will need, you are going to have to experiment.



Your instructor will show you how to do a pre-dive weight check that will help ensure you have sufficient weight to get down — without being egregiously overweighted.

At the end of every dive, however, you should conduct a precise check of weighting at safety-stop depth. To do this, hold at a depth of 5m/15 ft. Make certain your BC is completely vented. If you are properly weighted, you will be able to hover at this depth without having to fight to stay down or kick to keep from sinking.

If you discover you are not wearing the correct amount of lead, add or remove weight as needed before the next dive. Your goal should always be to dive with the *least weight possible* (Rule Number Five). Doing so makes controlling buoyancy easier, will help you keep your fins up off the bottom — and further helps ensure your likelihood of survival at the surface.

Scuba Tanks

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are the two most common materials used to make recreational diving tanks, and what are the advantages and disadvantages of each?*
- *What are the two most popular styles of valves used on scuba tanks?*
- *What periodic testing do scuba tanks require?*

The word *scuba* was originally an acronym standing for Self-Contained Underwater Breathing Apparatus. A key component of your scuba unit is the high pressure tank you use to take sufficient air or Nitrox with you on each dive.

Recreational scuba tanks are generally made from steel or aluminum. Aluminum tanks are more popular in North America, the Caribbean and parts of the Pacific. Steel tanks are more common in western Europe and elsewhere. Steel tanks are also more popular among technical divers.

- Steel tanks are typically available in larger capacities than aluminum tanks. They have very desirable buoyancy characteristics under water and require divers to use less weight. Steel, however, has one significant drawback: *It rusts.* This means that steel tanks require a higher level of care and maintenance.
- Aluminum's greatest strength is its resistance to corrosion — especially in and around salt water. Aluminum tanks *can't rust*, which helps explain their popularity among recreational divers.

The most commonly used tank among recreational divers in North America and the Caribbean is an aluminum tank with an internal volume of just under 11 L/ 0.4 ft^3, and a working pressure of 204 bar/3,000 psi. At its working pressure, this tank contains the equivalent of 2,200 liters or just under 80 cubic feet of air at the surface.

Tank Valves: Scuba tanks mate to your regulator first stage by means of a simple on/off valve. This valve may utilize one of two different types of connectors.

- *Yoke Valves:* The most common type of valve used by recreational divers in North America and the Caribbean has a simple orifice with a small O-ring embedded around it. The O-ring mates to an inlet on the regulator first stage, and is held in place with a simple, clamp-like yoke connector. When using this type of valve, it's important to inspect the O-ring ahead of time and replace it if it shows signs of damage or wear.

- *DIN Valves:* DIN valves have a deep, threaded orifice. Depending on the depth of the threads, they may be

rated for either 200- or 300-bar service. DIN valves are designed to mate to a similarly threaded male fitting on the regulator first stage. Doing so is about as challenging as screwing in a light bulb. Note that, with DIN fittings, the O-ring is embedded in the regulator first stage, not the valve.

Adapters are available that enable you to use DIN regulators with conventional yoke-style valves. Conversely, there are inserts you can install in 200-bar DIN valves that will enable you to use them with yoke-style first stages. This type of *convertible valve* is becoming increasingly common.

From time to time, you may also run into some unusual valve configurations.

- Although they have not been readily available for more than 25 years, you occasionally see what are known as *J-valves*. These have a reserve lever and date from a time before submersible pressure gauges. If you have occasion to use one, keep the reserve lever in the *down* position and rely solely on your pressure gage.

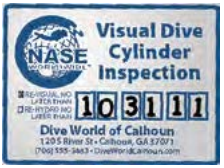
- You may see cave and technical divers using dual-orifice manifolds and valves designed for use with two separate regulators. Using these requires special training.

Care and Maintenance: As with all dive equipment, scuba tanks should be rinsed with fresh water following immersion in salt water. When rinsing scuba equipment, you need to take care to avoid getting water inside the tank or regulator.

- Scuba tanks require periodic *hydrostatic* or pressure testing. Depending on where you live, local laws or standards of practice may require this be done anywhere from once every year, to once every five years. The date of the last hydrostatic test will be stamped on the neck of the tank. Your dive center will inspect this prior to filling your tank to ensure it is current.

- Because corrosion or damage can occur to tanks between hydrostatic tests, tanks must also be *visually inspected* by a professional

dive center at least once every year. Proof of a current visual inspection is provided by a decal your dive center will affix to the side of your tank.



Before taking your tank to be filled, you need to check to make sure both the hydrostatic and visual inspections are current. As you will remember from our earlier discussion on the importance of safe breathing gas, get your tanks filled only at professional dive centers or resort dive operations.

An additional safety rule is that you should *never* leave a scuba tank standing upright, unattended, in a high-traffic area or on a rolling boat deck. Under these circumstances, tanks can be easily knocked over — possibly causing catastrophic valve damage.

If you want to leave a tank standing upright, it should be against a wall, in a special storage rack, or with other tanks, on a solid surface. Otherwise, leave the tank lying on its side, and blocked so it won't roll.

The neck of your tank will be stamped with additional information you may be interested in learning about. These markings will vary depending on where you live, but typically include: the material from which the tank is made, its working pressure, serial number and size. Your instructor can show you how to read these markings.

To Own...or Not? Although scuba tanks are often among the first things new divers think about buying, the fact is, you may not need to own one. Rental tanks are often available for little more than the cost of an air or Nitrox fill. This is good, because when you travel, it is impractical to take tanks and weights with you on airplanes.

In fact, if you are going to a destination that can only be reached by air, you can pretty much assume that use of tanks and weights will be included in your dive package.

Scuba Regulators

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is the primary function of scuba regulators?*
- *What are the five primary components of a scuba regulator, and what does each component do?*
- *What post-dive and periodic maintenance do regulators require?*

Despite the several tons of pressure the atmosphere exerts on the surface of our bodies, most of us find breathing here at sea level is as easy as, well... breathing.

There is a reason for this, too. The air we breathe here at the surface is at exactly the same pressure as the air surrounding us — what we call *ambient pressure.* As long as these two forces are in balance, we don't even notice them.

This is what scuba regulators do for us at depth. They deliver breathing gas, on demand, at exactly the same pressure as the water surrounding us — regardless of depth.

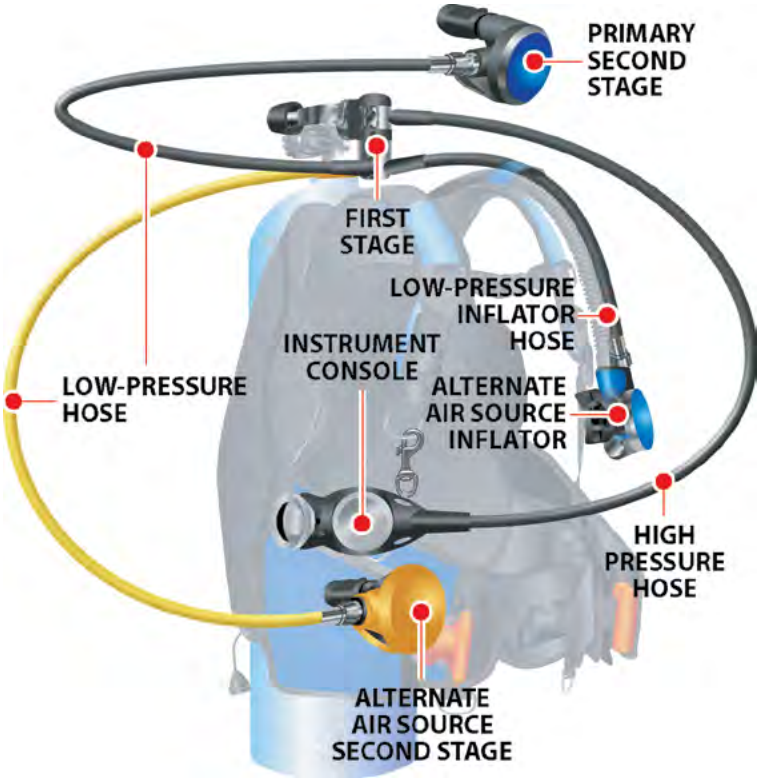
Modern regulators have five components:

- A first stage.
- A primary second stage.
- An alternate air source second stage.
- A low-pressure inflator hose.
- A high-pressure hose connecting to a submersible pressure gauge or instrument console.

First Stage: The regulator first stage is the heart of the system and the part that connects to your scuba tank. As you already know, your first stage may have either a yoke or DIN connector.

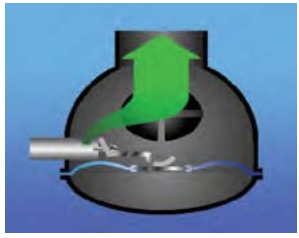
The first stage does more than just provide an attachment point for other system components. Its primary function is to reduce the high-pressure air in the tank to what is known as *intermediate pressure.*

Regardless of depth, intermediate pressure is always the total of the ambient pressure plus a fixed amount — typically 9-10 bar/135-150 psi. By reducing tank air to intermediate pressure, the first stage makes the job of the regulator second stages a lot easier — and, ultimately, allows for a lot better performance.



Primary Second Stage: The primary second stage is the part of the regulator we normally breathe from. Mechanically, it is actually very simple.

- When we inhale, we pull in on a *diaphragm*. The diaphragm then pushes against a *demand lever* — which, in turn, opens the second stage valve, allowing air to flow.
- When we exhale, the diaphragm returns to its original position. The demand lever closes, and our exhaled air escapes through a one-way mushroom valve at the bottom or side of the second stage.



Note that, on most second stages, the exhaust valve must be on the bottom or, as you exhale, water will come right back in. Some regulators have side exhausts, which help eliminate this problem.

Alternate Air Source Second Stage: The alternate air source second stage can be largely the same as the primary second stage. Its purpose is to allow you to provide breathing gas to another diver who has run out of air or is experiencing difficulty with his regulator. Alternate air source second stages are sometimes known as *safe seconds* or, more commonly, as *octopuses*.

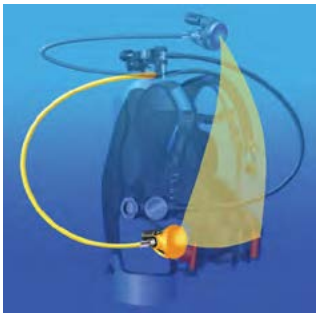
Alternate air source second stages usually have a slightly longer hose, and it and the second stage itself will be color coded yellow, for better visibility. Some divers prefer a side-exhaust second stage as their alternate, as a panicky diver *can't* put this in his mouth upside down.

As you already know, some divers replace the standard alternate air source second stage with an alternate air source inflator on their BC. This reduces the overall number of hoses in the regulator system by one.

The chief benefits alternate air source inflators provide are simplicity and streamlining. The chief drawback?

- With a conventional alternate air source second stage, it ultimately doesn't matter which second stage the out-of-air diver ends up with, so long as both you and he have a functioning regulator to breathe from.
- With an alternate air source inflator, you *must* give the out-of-air diver the primary second stage you normally breathe from, then pick up and begin breathing from the inflator.

As daunting as that may seem, remember that you can most likely find and pass a panicky diver the regulator that is in your mouth faster than you can even one that is properly secured to your BC harness.



Regardless of which system you choose, the regulator you intend to pass to another diver should be located or secured in the triangular area between your mouth and the corners of your rib cage.

Low-Pressure Inflator Hose: When you purchase your scuba system, you will discover that the low-pressure inflator hose for your BC comes with the BC — even though it attaches to your regulator. Most low-pressure inflators use a standard hose fitting. Alternate air source inflators, however, require a proprietary hose designed to deliver more gas.

High-Pressure Hose: Your high-pressure hose comes from a part of the first stage that bypasses the intermediate pressure chamber. It will contain air at exactly the same pressure as what is in your scuba tank.

Your high-pressure hose will connect to either a simple submersible pressure gauge or a multi-gauge console. On some regulator systems, the high-pressure hose is replaced by a sending unit that transmits a digital pressure signal to a wrist-mounted dive computer. We'll discuss instrumentation in greater depth in the next section.

Care and Maintenance: As common sense would suggest, the most important feature when selecting a regulator is *ease of breathing*. Obviously, no manufacturer makes a regulator that offers anything less than very good performance out of the box.

What you need to be aware of is what keeps your regulator performing "as new." That is *regular inspection and service by trained technicians*. The typical regulator needs a complete rebuild at least once every year — regardless of how much or how little you use it. You should factor in how easily you can get this service, and its cost, as part of your buying decision.

As with all dive gear, after every dive in salt water, your regulator will need to be rinsed thoroughly in fresh water. If need be, your instructor will show you how to do this.

Your regulator system is a key component in your scuba unit and a vital piece of life support equipment. Under water, it keeps you alive. Select yours carefully and treat it with the respect and care it deserves.

Instruments and Gauges

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What four pieces of information do divers require in order to dive safely?*
- *How do divers monitor tank pressure?*
- *How can divers monitor depth and time?*
- *How do divers monitor direction?*

Every diver needs four pieces of information to dive safely. These are:

- Tank pressure.
- Depth.
- Bottom time.
- Direction.

To access this vital data, divers use a variety of instruments and gauges.

Tank Pressure: While divers face an assortment of potential problems, there is only one true diving emergency: *Being without something to breathe*. As long as you have air to breathe, all other problems are solvable.

Odds are you've seldom — if ever — run out of fuel in your car, truck or SUV. The chief reason you haven't is that you have a gauge to tell you how much fuel you have, and when you are getting low.

Divers have the same thing. It's called a *submersible pressure gauge, contents gauge* or *SPG*. Just as your gas gauge helps prevent you from getting stranded on land, your SPG helps you avoid running out of air under water.

SPGs can come in many forms. The simplest are mechanical gauges found at the end of your regulator's high-pressure hose — usually in a console with one or more other instruments.

Your SPG can also come in the form of a digital display on a wrist or hose-mounted dive computer. As you learned in the last segment, you can replace your regulator's high-pressure hose with a transmitter that broadcasts a signal to a wrist-mounted computer.

Depth and Bottom Time: In Unit Four, you'll learn more about the need to remain within certain depth and time limits in order to avoid *decompression sickness* or *DCS*. To do so, however, you will need a means of monitoring depth and bottom time.

The best way to do so is with a dive computer. Computers not only track and record your dive profile, they also tell you when to ascend in order to avoid DCS or the need to make mandatory decompression stops.

Dive computers can come in a multi-gauge console with an SPG and/or compass. They can also come in a single-gauge console that integrates two or more of these functions. Wrist computers are also popular. Some are so small they can be worn as a watch.

If you don't have a dive computer, you will need a depth gauge and some form of timer, and use them in conjunction with dive tables. Mechanical depth gauges usually come in the form of a multi-gauge console that includes an SPG and, possibly, a compass.

The most common form of dive timer is a waterproof watch. Electronic gauges that track both depth and bottom time are also available; however, as these cost nearly as much as a basic dive computer, it makes more sense to just buy a computer.

Direction: Knowing where you are under water, and how to get back to your entry and exit point can help you save a long, tiring — and potentially hazardous — surface swim. Most of the time, divers find their way under water using *natural navigation* — that is, following a series of landmarks, such as a reef line or bottom contour.

Sooner or later, however, divers face directional challenges that natural navigation won't solve. That's when your compass comes in.

Modern underwater compasses can be read from the top or side. They are most often found on the back or end of a multi-gauge console. Wrist compasses are also available. Some divers will go so far as to mount their compasses on a retractor or slate.

A fairly recent development is electronic compasses that are integrated into your dive computer. These have the benefit of being very accurate and

very easy to read. They also eliminate the need to hold the compass perfectly level, which is essential when using mechanical compasses.

The role each of these instruments play will be addressed extensively throughout the balance of the course. Just bear in mind that gauges only work if you pay attention to them.

Exposure Protection

Baby, it's cold down there. But it doesn't have to be uncomfortable. With the right exposure protection, water of any temperature can be enjoyable. Just as the right cold-weather clothing makes skiing and other winter activities fun, the right exposure suits and accessories help make diving a blast.

Exposure Suit Overview

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *Why do divers wear exposure suits?*
- *What factors do you take into account when selecting an exposure suit?*

Divers wear exposure suits primarily for thermal protection — although exposure suits provide the added benefit of helping protect from cuts, scrapes and abrasions. As you read in Unit One, water conducts heat away from your body up to 25 times faster than air. As a generalization, it is very difficult to be too warm under water; however, without adequate exposure protection, it is very easy to be too cold.

Exposure suits range from lightweight dive skins to dry suits worn over insulative undergarments. The right exposure suit to wear under any given set of conditions will depend on a variety of factors, including the water temperature at depth, air temperature and length of exposure. In general, it is a rare body of water in which divers do not need a minimum of at least a full-length, one-piece wet suit.

Dive Skins

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are dive skins?*
- *What are dive skins' primary function?*
- *For what other reason do divers wear skins?*

Dive skins are thin exposure suits made from Lycra, nylon, or other synthetics. By themselves, skins can help provide protection from sun, stings and abrasions. In extremely warm water, some divers will wear skins in lieu of a wet suit — although the thermal protection skins provide is very minimal.

Many divers wear skins under their wet suits, as doing so can help make the wet suits easier to don. A skin may also cut down on water circulation through the suit, helping divers maintain warmth.

Dive skins are available in full-length models. T-shirt style "rash guards" are also popular.

Wet Suits

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are wet suits?*
- *What happens to wet suits as you descend?*
- *Why is a good fit important when wearing a wet suit?*
- *What risk factors are associated with wearing wet suits out of the water?*

Wet suits are by far the most popular form of exposure protection. They are available in a variety of styles and thicknesses, and can help divers remain comfortable in water as cold as 10 °C/50° F.

Wet suits are made from neoprene foam, a flexible material that provides excellent insulation in shallow water. As divers descend, however, neoprene foam compresses, causing it to lose some of its insulation qualities, as well

as causing divers to lose buoyancy. As you already know, divers use their BCs' air cells to compensate for exposure suit compression and expansion.

To work effectively, wet suits must fit snugly. This minimizes the amount of water that enters the suit and helps prevent cold water from circulating freely.

Wetsuit styles range from thin "shorties" (short arms and legs) to full-length "farmer john" styles that provide a double layer of insulation in the torso area. The most popular wetsuit style is a full-length, one-piece jumpsuit, available in thicknesses from 3.0 mm to 7.0 mm. One-piece jumpsuits can be layered with hooded vests or shorties for added warmth.

Overheating and Cooling: In cold weather, a dry wet suit can help keep you warm before dives. Conversely, in hot weather, donning a wet suit too soon before diving can put you at risk of heat stroke or heat exhaustion. Use common sense and remember that you may want to wait to don your wet suit until just before you dive, or at least hop in and cool off before donning your scuba unit.

Once your wet suit is saturated with water, it is unlikely you will overheat; nevertheless, you may want to remove the upper portion of the suit if you feel uncomfortable. In cold weather, you may want to change into dry clothes between dives, as wind blowing on your damp suit may increase evaporation and chilling.

Exposure Suit Accessories

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are the three most common exposure suit accessories?*
- *How much heat can divers lose through their heads and how can you prevent this?*
- *What are the two reasons divers wear gloves?*
- *Why do divers wear boots?*

Hoods: Up to 75 percent of the heat loss divers experience can come from their heads. To be comfortable in water below 21° C/70° F. you should wear a hood (many experienced divers wear hoods in water warmer than this). Hoods are made from neoprene foam of various thicknesses and in different sizes and shapes. Some wet suits and neoprene vests are available that have hoods attached.

How a hood fits is important. As with wet suits, hoods must fit snugly so that water does not circulate. On the other hand, a hood must not fit so tightly around the neck that it causes constriction of the carotid arteries. Constriction in this area can cause elevated heart rate and elevated blood pressure, which could lead to more serious consequences under water.

Gloves: Dive gloves are generally worn for thermal protection, although some divers will use lightweight gloves for protection from abrasions, cuts and scrapes. Cold-water gloves and mitts are generally made from neoprene foam. Be aware than many warm-water dive operations and resort destinations prohibit the use of gloves so that divers will think before indiscriminately touching coral.

Dive Boots: Dive boots help protect your feet from cuts, punctures and abrasions, as well as provide thermal protection in cold water. As you learned in Unit One, open-heeled fins are generally designed to be worn with boots.

Dive boots can be purchased in various thicknesses, high- or low-cut styles, and with soles of various thickness and hardness. The kind that you buy will depend upon the environment you use the boots in. Buy your dive boots and fins together to assure a good fit.

Dry Suits

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are dry suits?*
- *What type of conditions are dry suits best suited for?*
- *What is required to use a dry suit?*

Dry suits are watertight shells worn over thermal undergarments — although dry suits made from neoprene foam don't require as much insulation. Drysuit undergarments can be made from different materials and come in different thicknesses, depending on the degree of insulation you need.

Dry suits can be worn in very cold water. They generally include watertight seals at the neck and wrists. Some dry suits include ankle seals if they do not have built-in boots.

Dry suits include a low-pressure air fitting and an overpressure relief valve. The dry suit is connected to your regulator first stage through a low-pressure hose. As you descend, air in the dry suit will compress and you will add gas from your tank to compensate. As you ascend, the gas will expand and, to maintain neutral buoyancy, you allow the air to escape through the deflator valve.

Use of dry suits requires specialized training. Ask your instructor.

Additional Equipment Items

Cutting Tools: Divers use tools to cut, measure and pry. Such tools are especially useful in case of entanglement in fishing line. Dive knives and cutting tools come in many sizes and shapes. Common styles include knives, shears and line cutters.

Cutting tools need to resist rust, and are usually made from stainless steel or titanium. Knife-style cutting tools may have a knife edge, a serrated edge for sawing, and/or a notch for catching and cutting line. Some knives have blunt points that can be used for prying.

Dive Lights: Dive lights can not only provide illumination on night dives, they can also be used during daytime dives to cast light into holes, cracks, and crevices. As you learned in Unit One, light from the surface is absorbed, reds first, which tends to shift everything toward blues and grays the deeper you go. A dive light can help restore the colors you would see closer to the surface.

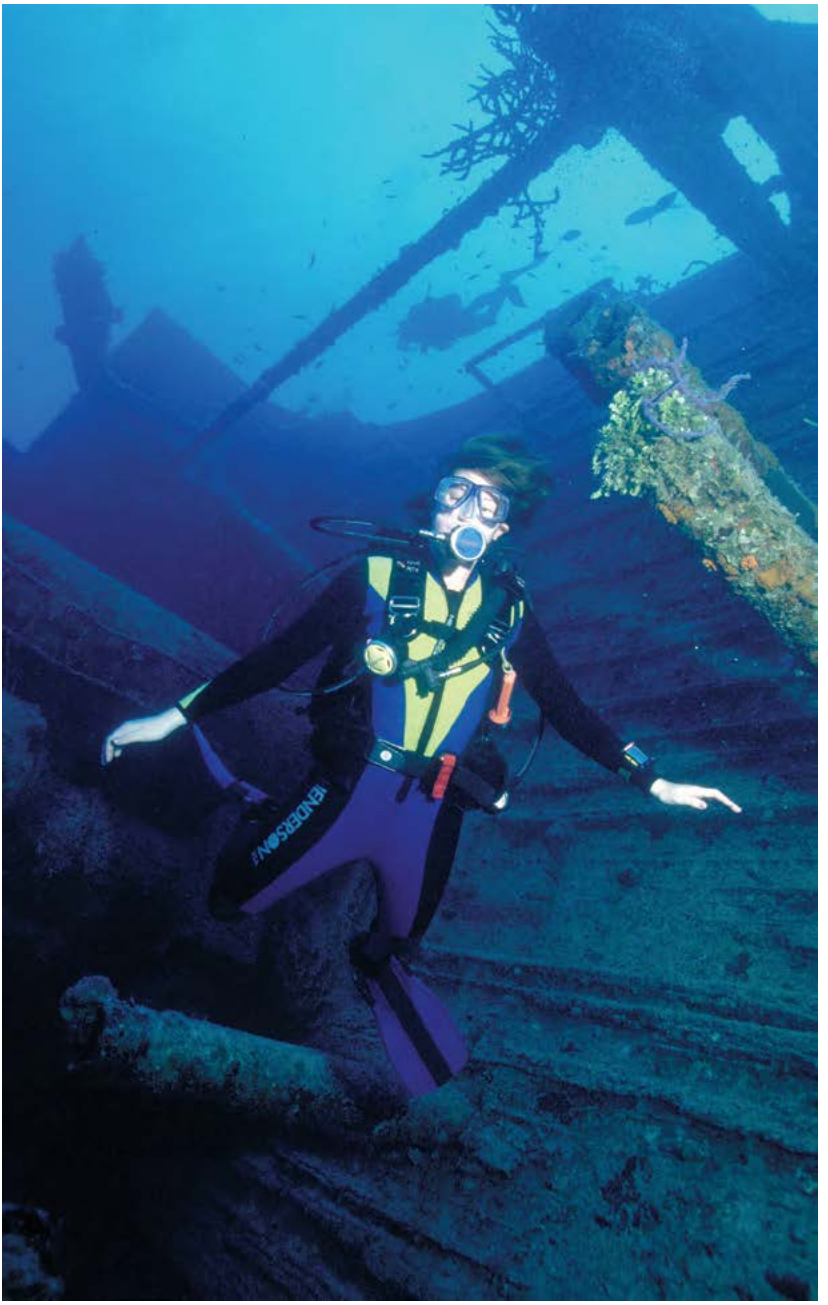
Equipment Bags: Equipment bags are a convenient way to keep your diving equipment together and provide an easy means for transportation to the dive site. They come in a large variety of styles and colors, including some styles with backpack straps for easy carrying or wheels for pulling through airports.

Most dive boats will require that you keep your diving equipment together on the deck of the boat in a dive bag to avoid clutter and the possibility of having your valuable equipment kicked overboard when not in use.

Signal Tubes: A signal tube is an inflatable tube that extends to about 1.5 m/4.5 ft long. This makes divers more visible at the surface and is helpful when you need to be seen by others over long distances.

Congratulations…

You've completed Unit Three. Don't forget to go back and complete the Study Questions for this unit before proceeding to Unit Four.



Unit Four

Unit Four covers a variety of topics, including:

- Dive Planning
- Problem Recognition and Control
- Boat Diving
- Managing Exposure to Nitrogen
- Odd and Ends
- Continuing Education

Dive Planning

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are some of the typical components of a dive plan?*

Pre-dive planning is one the best assurances of an enjoyable dive. In the process of planning the dive, you can avoid disappointments because of forgotten equipment or poor diving conditions. In this section you will learn about:

- Advance preparation.
- Equipment preparation.
- Save-a-Dive kit.
- Pre-dive preparation.

Advance Preparation

First, choose the dive site or destination. Next, choose a dive buddy, keeping in mind each person's level of training. Together, determine the intent of the dive — photography, hunting, game collecting, or just pleasure.

Having an understanding and agreement about the activities of the dive will help you and your buddy stay together during the dive. Determine the best time to dive. Discuss logistics. If not taking part in a dive charter, do as the dive boat captain would and check the local weather. A recent storm in

the area may effect the diving conditions, as will an approaching storm. If a storm approaches, diving conditions may change quickly, turning a normally calm dive into a dangerous situation. If diving in an area where tides are a factor, consult local tide tables and become familiar with the effects the tides have in the local area.

If you won't have a dive boat crew to rely on, know how to activate the local emergency services. Write down any pertinent phone numbers and identify the nearest telephone.

If diving on your own, file your dive plan with someone who isn't going on the dive with you. Include your expected return time and specific instructions if you are delayed. Gather your personal gear — certification card, log books, maps of the area, lunches, water, sun protection, jacket and hat.

Equipment Preparation

Inspect all the equipment you will be using. Give yourself enough time for any equipment repairs or replacements. Make an equipment check list and put all your dive gear in one area. Using the checklist, check each item to make sure nothing is forgotten.

If using your own scuba tank, make sure it is filled and that the air is fresh. Pack your equipment bag so that the last item in is the first item that you will need to take out. Make a final check so that you do not forget anything.

Spare Parts Kit

There is nothing more frustrating than having a whole day's dive trip ruined because you broke a strap and no one has a spare. By assembling a spare parts

(*save-a-dive*) kit and always carrying it with you, you can minimize the probability of missing a dive because of a minor problem.

A save-a-dive kit is simply a collection of spare parts. What you put in the kit is up to you. Here are a few suggestions:

- Mask strap
- Low pressure regulator hose
- Fin straps
- Wetsuit cement
- Snorkel keeper
- Pliers
- O-rings
- Screwdrivers
- Quick-release buckle knife
- Tie wraps
- High pressure hose
- Mouthpiece
- Low pressure inflator hose
- Pocket knife

Pre-Dive Preparation

If diving from shore, evaluate the conditions from an elevated viewing point. Decide whether conditions at the dive site are favorable. If the conditions are bad, or beyond your experience level, don't dive. If you choose an alternate dive site, notify someone that your dive plans have changed.

Decide on entry and exit points into and out of the water and discuss your entry and exit techniques. Decide on a course to follow. Review hand signals and any other communications. Discuss what you and your buddy will do if you get separated. Agree on depth, times and return air pressure. Discuss what to do if an emergency arises.

When you and your buddy plan your dive (and dive your plan) you will find that the dive will be safer, easier and more enjoyable.

Problem Recognition And Control

In this section you will learn about:

- Problems at the surface.
- Basic concepts of diver assistance.
- Overexertion.
- Out-of-air emergencies.
- First aid for diving emergencies.

What to Look For

As you read through this section, highlight or underline the answers to the following:

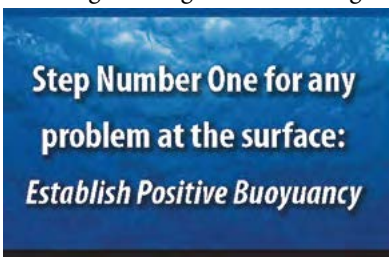
- *Where do most diving problems occur? How can you recognize them?*
- *What is the first step in assisting divers who are experiencing difficulty at the surface? What are the subsequent steps?*
- *What problems may divers run into under water, and how do you respond to them?*

Diving within your limitations, using safe diving techniques, and following your dive plan will help you avoid problem situations. As you keep yourself physically fit and maintain your diving skills problems can be avoided. If a problem does arise, you will want to be able to care for yourself and your buddy.

Problems at the Surface

Most problems divers experience take place at the surface. Surface problems can be prevented or controlled by diving within your limits, relaxing while you dive, and establishing positive buoyancy while you are at the surface.

Some possible reasons for problems at the surface are overexertion, cramps and choking. If choking on water, hold your regulator in your mouth and cough through it. Swallowing sometimes helps to relieve choking.



Always keep your mask in place and maintain sufficient buoyancy, since each cough lowers your lung volume and decreases your buoyancy.

If a problem occurs at the surface, immediately establish positive buoyancy by either inflating your BC or by

dropping your weights. Do not hesitate to signal for help. Wave your hand or use a whistle, if you have one.

Basic Diver Assistance Concepts

The basic concepts in managing a diving problem are recognizing a problem, managing a problem at the surface and under water, and assisting another diver.

Before you can assist another diver, you must first know if the diver is in need of help. You must be able to recognize the need and then follow with immediate action. A diver who is in need of assistance but is in control will signal for help. A diver in control normally appears relaxed and is breathing normally. The diver will have his or her equipment in place, be attentive and move in a slow and deliberate manner.

Divers who lose control typically struggle to hold their head above the water. They may abandon their regulator and shove their mask up onto their foreheads. This is the symptom of a panicked diver at the surface.

A diver about to experience a problem will generally be anxious and breathing rapidly and shallowly. He or she pays no attention to others and makes quick, jerky movements. The eyes are wide and unseeing. Divers exhibiting these signs are in need of immediate assistance because they will continue to fight until completely exhausted and will be unable to stay afloat.

Panicked divers may be difficult and dangerous to deal with. Without specialized rescue training, the best way that you can assist a panicked diver at the surface without endangering yourself is to provide flotation in the form of a life vest, life ring, inflated BC or any other thing that may provide sufficient flotation. Throwing a life ring with a rope attached and towing the panicked diver to safety would be the best approach, if available.

If you cannot provide a panicked diver with a flotation device, inflate the diver's BC or discard the weighs. Once you have established the diver's buoyancy, the next step is to calm the diver. You can calm a diver by talking in a slow and calm manner. Offer encouragement and persuade the diver to relax and breathe normally. Encourage deep, slow breaths. This will help the diver to relax. If necessary, help the diver back to the shore or boat.

Overexertion

Overexertion may give you the feeling of air suffocation. If you do become overexerted, stop, hold onto something, relax, and breathe slowly and deeply to restore your normal breathing pattern. Overexertion can be prevented by pacing yourself and breathing deep, full breaths.

Out-of-Air Emergencies

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *How can you prevent out-of-air emergencies?*
- *What are your two possible responses to an out-of-air emergency?*
- *What are the benefits of making an alternate-air-source ascent?*
- *How do you make an independent emergency ascent?*

By far the best way to deal with an out-of-air emergency is to *never have one*. Starting with a full tank, having a dive plan that addresses minimum ascent pressure and, in particular, monitoring your SPG regularly will help ensure this is something that happens *to the other guy*, not you.

Nevertheless, you need to know what your options are and be prepared. In the unlikely event you suddenly find your regulator breathing hard, you need to make a very immediate — and very important — decision. That is:

> *Are you 100 percent confident you can make it to your buddy's alternate air source before finding yourself completely without something to breathe, or not?*

Don't waste time searching for your SPG or trying to figure out what is wrong. It won't make matters any better. If your regulator is not giving you the air you need, you need to act and act quickly.

- If you have been maintaining close contact with and paying attention to one another, there is a good possibility that the answer to this question will be *yes*. That's important, because

an alternate-air-source ascent is clearly the best way to deal with an out-of-air emergency, short of prevention. It helps ensure that both divers will be able to breathe continuously throughout the ascent, and will most likely be able to make a slow ascent and safety stop.

- If, on the other hand, you are not confident in your ability to make it to your buddy's alternate air source in time, you can still make an independent *emergency swimming ascent* (*ESA*) — although doing so does entail some risks that would most likely *not* be present if ascending on a buddy's octopus, chiefly due to the rapid rate of ascent.

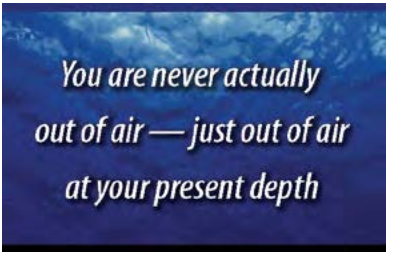
Alternate-Air-Source Ascent: As you already know, if your buddy is equipped with an alternate-air-source inflator, you will need to get his attention, signal *out-of-air/share air* and wait for him to pass you his primary second stage. You can do the same thing if your buddy has a conventional alternate-air-source second stage — or you can simply take the alternate and begin breathing from it.

Once you are breathing normally, confirm with your buddy that he understands the situation and agree to ascend. Take a position where you and your buddy are either holding on to one another's right BC shoulder straps with your right hand or using your right hands to grasp each other by the right wrist. This does four things:

- By holding on to one another securely, you help reduce the risk of a regulator accidentally being pulled out of the receiver's mouth.
- You leave both of your left hands free to vent your BCs during ascent — and immediately inflate them upon surfacing.
- You position yourselves slightly off-center from one another, so that you are less likely to be kicking each other's fins during ascent.
- You help ensure that the donor's second stage hose will make fewer sharp bends going to the receiver's mouth.

From here, things are pretty straightforward. Make a slow ascent and, if possible, a safety stop while maintaining hand and eye contact with one another. Remember that, upon surfacing, the out-of-air diver will most likely need to *orally* inflate his BC.

Independent Emergency Swimming Ascent: If you find yourself unable to breathe at depth, you actually have two very important things going for you:



- Even though it may feel as though your lungs are less-than-full, they may actually contain the equivalent of one or more lungfuls of air at the surface. In fact, as you ascend, your challenge will not be having sufficient air, but rather venting the expanding air at a rate that will help prevent a lung-overpressure injury.
- Even though your regulator may be breathing hard (or not breathing at all), your tank *is not* empty. You are simply at an ambient pressure where the regulator is not able to function normally. As you ascend, and the ambient pressure drops, you will most likely be able to get one or more partial breaths on the way up.

One thing you *do not* want to do is spit your regulator out. For reasons that have mystified diving educators for decades, out-of-air divers often seem possessed by the urge to get rid of the one piece of equipment that could save their lives. Remember:

- Your regulator second stage is a one-way valve. It allows the expanding air to escape during ascent while keeping the water out.
- Your regulator can give you one or more partial breaths on the way up — but not if you have to hunt for it, and find the air to clear it before breathing.

The only time you should *ever* take a regulator out of your mouth during an out-of-air emergency under water is when you are about to put another diver's alternate-air-source second stage in.

Now here is what you *should* be doing in this situation:

- *Remember Rule Number One:* Breathe continuously; *never* hold your breath. As you are not likely to be able to breathe in, *breathe out*. Making a continuous "Ahh" sound will help ensure you vent air at a rate that will prevent a lung-overpressure injury — without the risk of exhaling too much.

- *Start swimming for the surface:* Maintain as close to a normal rate of ascent as you can.
- *Find your BC's deflation mechanism:* You will very likely need to vent air from your BC to maintain a slow rate of ascent. At the very least, you want to be ready to orally inflate your BC orally as soon as you reach the surface.
- *Consider taking your weight belt or a weight pocket off and holding it in front of you:* This way, if you do not think you will make it to the surface otherwise, all you have to do to ensure you get there is to *let go.* (At the very least, keep a hand on your weight belt buckle or a weight pocket release.) If do end up dropping weight, keep in mind you will need to arch your back and flare your arms and legs as you approach the surface to slow yourself down as much as possible.

- *Stop periodically and attempt an inhalation:* You will likely get at least a partial breath when you do.

As long as you are either making a continuous "Ahh" sound or attempting an inhalation, your risk of lung overpressure injury is small and your odds of making the surface are good. The chief concern with ESAs is that, despite your best efforts, your rate of ascent is going to be faster than normal. Monitor yourself for signs and symptoms of decompression sickness for the next several hours.

While it is nice to know that you have options in the event of running out of air, doing so is no substitute for prevention. Monitor your SPG throughout the dive and ascend with an adequate reserve.

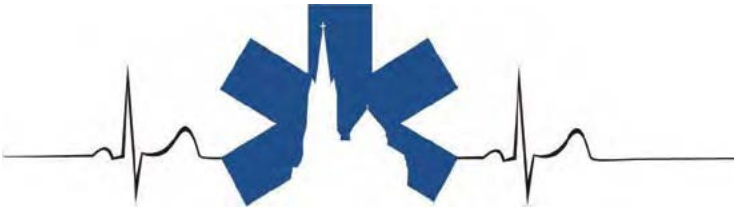
First Aid for Diving Emergencies

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What should you do if you encounter an unconscious diver under water?*
- *What should you do with an unconscious diver you find or bring to the surface who is not breathing?*
- *What is the first thing you should do upon exiting the water with an unconscious diver?*

Near drowning occurs when an unconscious diver has been submerged in water but is resuscitated at the surface. It can be caused by overexertion, lung over pressurization, attempted inhalation of water, over medication, aquatic life injuries, diabetic or other seizures. These can cause inefficient breathing, stoppage of the heart, and unconsciousness. If a diver is discovered unconscious underwater, he or she must be brought to the surface. Once the unconscious diver is at the surface, establish positive buoyancy and signal for assistance. Check to see if the diver is breathing or if the heart is beating.



If the diver is not breathing, start mouth to mouth ventilation or, if there is no pulse and conditions allow, perform CPR as required. Alert the emergency medical system and continue until someone relieves you. Once on land, assistance must continue. If the diver is unconscious but breathing normally:

- Maintain an open airway
- Keep the patient on his or her back with feet elevated
- Keep the patient warm and provide oxygen if available

These procedures also apply to any diver who, after a dive, becomes unconscious or who may have symptoms of a lung overpressure injury.

These symptoms can include chest pain, difficulty in breathing, confusion and visual problems, and paralysis.

Boat Diving

In this section you will learn about:

- Finding your way around.
- Pre-dive preparation.
- Diving procedures.
- Equipment management.

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *When should you plan to arrive at the dive boat?*
- *What are some typical components of the crew's pre-dive briefing?*
- *What general rule applies to the dive deck?*

Boat diving generally offers access to the best dive sites, the most aquatic life and the best visibility. Boats can carry you to dive sites that are inaccessible by land. Boat dives can eliminate long hikes to and from dive sites, long surface swims and the need for surf entries.

Pre-Dive Preparation

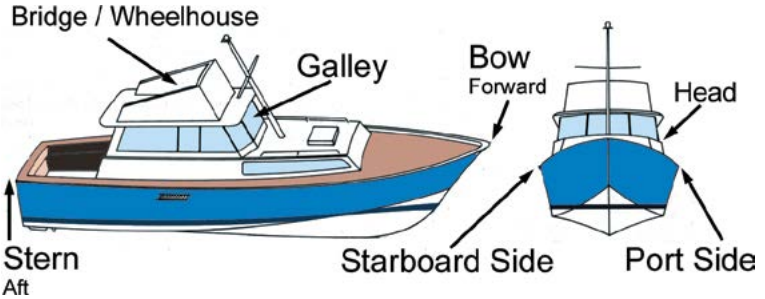
Before leaving for a boat trip, spend time preparing your equipment.

- Inspect all your equipment for potential problems.
- Assemble a spare parts kit.
- If you will be using your own tanks, fill them with air or Nitrox.
- Mark your equipment; most equipment looks the same on a crowded boat.
- Make sure your equipment is packed in a proper gear bag for transport to and from the boat, and storage once on board.

Boat Diving Procedures

Exact procedures will vary from vessel to vessel. Here are some common ones; however, specific instruction from the crew of your dive boat take precedence.

- When diving from a boat, arrive at least one hour before departure (earlier if instructed). This will give you time to check in, complete all necessary paperwork, find a place for your equipment and assemble your scuba unit.
- On overnight trips, you may be assigned a specific bunk and a place to store your dry and wet gear (although this is often allocated on a first-come/first-serve basis).
- If you tend to get seasick, take motion sickness medication if allowed by your physician, and avoid eating greasy foods before arrival. Staying in fresh air on the deck and standing in the center near the rear of the boat is helpful. Focusing on a stationary object on the horizon will also help.
- The ride to the dive site may take a few minutes or several hours. Once the boat ride gets under way, you can prepare yourself and your equipment.
- When the boat is anchored at the dive site, a dive site orientation will most likely be given by one of the crew. Listen closely to these instructions.



- The captain or a crew member will give the final okay to dive. As you put on your equipment, be careful. It is easy to lose your balance on a boat that is pitching. Have your buddy help with the donning of the scuba unit. Avoid dropping equipment since this can damage the boat beck, the equipment, or injure other divers. If using a weight belt, step over it to put it on, otherwise, you may hit something as you swing it around your waist. Put your fins on immediately before entering the water. Have your buddy assist you with this task.

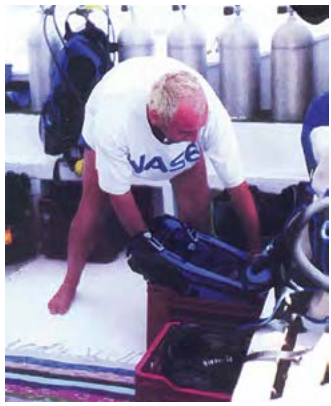
- Before entering the water, check with the divemaster or crew member. The crew will designate a place to leave the boat. On larger boats, the most common entry is the giant stride. On a smaller boat you may use another more appropriate entry as described by the crew or dive operator. Once in the water, have someone hand you any equipment you will be using such as

a camera, video systems, lights or spearguns.

- Before the dive, make sure that you understand the boat's recall system and procedures. If you hear this signal under water, follow the procedures the crew will outline during the briefing.
- As you ascend, keep a hand extended over your head for protection. When you break the surface, signal the divemaster or crew member that you are *okay*. In the unlikely event that you surface and the boat is not in sight, stay calm and establish positive buoyancy. The captain may have had to move. Relax and wait for the boat to return.
- When you reach the boat do not crowd the exit area, in case the diver ahead of you falls or drops a piece of equipment while exiting. Allow the divers ahead of you to exit one at a time.
- When it is your turn to exit, hand any accessories like cameras or spearguns to a crew member or another diver. Keep all other equipment attached until you are aboard.
- If you need to remove your fins before you can climb the entry ladder, maintain a good grip on the swim step or ladder. Otherwise, the current may carry you away and you won't have your fins on to swim back.
- Once on board, clear your equipment from the deck. Rinse cameras, lights or other accessories in fresh water, if available. Dive boats usually provide freshwater pails for this purpose.

Equipment Management

Dive boats are very active places. Not only must the divers' needs be taken care of, but the boat's needs as well. A cluttered deck is not only a difficult place to work and get around but also a safety hazard. Most dive boat operators will appreciate and require that you keep your dive gear together in one place while it is not in use. A convenient way to do this is to "dive out of your gear bag."



In other words, keep your equipment together in your bag when you are not using it.

This practice will also minimize the possibility of having an expensive piece of equipment kicked over the side of the boat and lost while it is not being watched.

Buddy System and Communication

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is the number one reason for diving with one or more buddies?*
- *What should you do if separated from your buddy(s) under water?*
- *What are some of the most common hand signals used by divers?*

Why dive in teams? The number one reason for diving with one or more buddies is safety. You already know that in an out-of-air situation, a nearby buddy with an alternate air source can be a lifesaver. Buddies can also help with entanglement, debilitating sickness or injury, and a host of other problems.

Going with others also makes diving more fun. Most of us find shared experiences more enjoyable. There are also factors such as the ability to help one another suit up and the added value of having more than one person to assist in planning, logistics, etc.

Buddy Separation: It happens and, when it does, you will want to reunite with your team members just as quickly as possible.

The standard procedure for buddy separation is to look for no more than one minute, then meet on the surface. During this time, you can look in all directions, rise above any disturbed sediment near the

bottom and, if your buddy(s) were behind you, backtrack along your direction of travel.

If you can't locate your buddy(s) within one minute, ascend slowly, make a safety stop, then surface. Your buddy(s) should be doing the same thing, allowing you to all meet on the surface. If your missing team member(s) *do not* join your on the surface within a reasonable time, summon more qualified assistance. Do not put yourself at risk by searching for them alone.

Communication: Even when they cannot talk to one another, divers can communicate in a variety of ways.

- Under water, the most common form of communication is hand signals. Your instructor will introduce you to several of these, and you will practice them throughout the course. Erasable slates provide yet another means of communicating under water.
- Audible signals, such as "tank bangers," rattles and air horns can be used to gain attention over longer distances under water. Whistles and air horns can also be used to signal for help on the surface.
- Visible surface signals include inflatable safety tubes and signal mirrors.

Managing Exposure to Nitrogen

Being able to manage exposure to nitrogen is among the most important skills any diver can possess. It not only helps you avoid decompression sickness, it can also help you enjoy longer bottom times and shorter surface intervals.

No-Decompression Limits (NDLs)

What to Look For

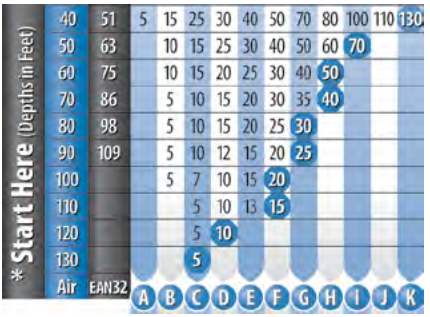
As you read through this section, highlight or underline the answers to the following:

- *What are the limits that recreational divers must remain within to minimize the risk of decompression sickness (DCS)?*
- *What must divers do if they accidentally exceed a No-Decompression Limit?*
- *What does planned decompression diving require?*

In Unit One you learned about nitrogen absorption and decompression sickness (DCS). When you dive, you absorb nitrogen from the gas you breathe. When you ascend, your body begins to release this excess nitrogen through respiration.

As long as you ascend slowly, and keep the amount of dissolved nitrogen in your body within certain limits, it will most likely *not* cause any problems. If you allow too much nitrogen to accumulate, or you ascend too quickly, the excess nitrogen may come out of solution faster than your body can eliminate it through respiration.

When this happens, nitrogen bubbles may form that can block the flow of blood or put pressure on nerve endings — what we call *decompression sickness* or *DCS*. As you know, this is a serious medical condition and can cause considerable pain, long-term injury and, in extreme cases, even death.



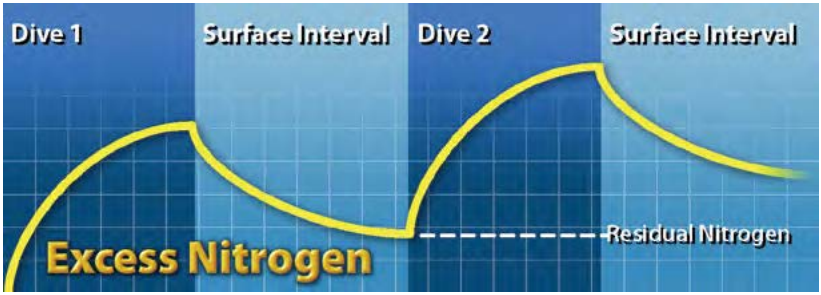
Steps you can take to avoid decompression sickness include ascending slowly and keeping the overall levels of excess nitrogen in your system within certain limits.

We call these *no-decompression limits* or *NDLs*. You can determine the NDL for any particular set of depths and times by using dive tables or, better still, a dive computer.

If you exceed an NDL, you must make a series of decompression stops to allow excess nitrogen the opportunity to come out of solution more slowly than it would if you went directly to the surface. Decompression diving entails hazards and risks that go well beyond what you learn about in a beginning scuba course, and requires special training and equipment. This is why it is important for recreational divers to remain well within the no-decompression limits.

Residual Nitrogen

Residual nitrogen is excess nitrogen remaining in your system from previous dives. Residual nitrogen levels drop the longer you remain on the surface (generally returning to normal within twelve hours or less). The accompanying chart shows how nitrogen levels rise and fall during dives and surface intervals.



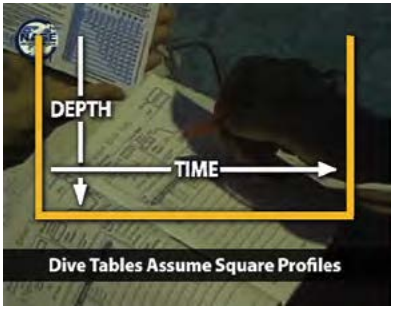
Note that, if you do not completely off gas the excess nitrogen in your system before making another dive, you must account for it when determining your no-decompression limits.

Introduction to Dive Computers

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *Why do dive tables limit the amount of time divers can spend under water?*
- *How is it dive computers appear to "give" divers more time under water?*
- *Why must dive computers be used conservatively?*



Dive tables assume what are called *square profiles*, that is that the entire dive was spent at the deepest depth. This can severely limit your available bottom time.

Dive computers, on the other hand, monitor your actual depth and time, and allow credit for time spent in shallower water. As such, they appear to "give" divers longer no-decompression limits. In actuality, they merely recognize the time that is available to you, based on your actual dive profile.

It is important to understand, however, that dive computers do not actually monitor the amount of dissolved gas in your blood and tissues. Instead, they work an algorithm designed to model the uptake and release of nitrogen in an average diver.

In so far as actual susceptibility to DCS varies from diver to diver (and even from day to day), it is important to use dive computers conservatively, staying well within the no-decompression limits they provide.

Dive Computer Modes

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are the different modes of dive computer operation and what can you do in each?*

Dive computers operate in various *modes*, depending on what you are doing, and what you are asking the computer to do. The two primary modes are *Dive Mode* and *Surface Mode*.

- During *Dive Mode* the dive computer continuously monitors your depths, dive time, and water temperature. Nitrogen levels are calculated many times a minute for multiple tissue compartments. Because these calculations are made frequently, nitrogen levels calculated by the computer more closely match the actual nitrogen levels in various body tissues than can be determined from a table.
- During *Surface Mode* the computer estimates your declining residual nitrogen levels over the surface interval. The computer can then take residual nitrogen into consideration when it calculates nitrogen levels for the next dive.

We will take a more in-depth look at these and other modes, as well as some common dive computer features next.

Dive Computer Features

What to Look

For As you read through this section, highlight or underline the answers to the following:

- *What four things will your dive computer tell you while in Dive Mode?*
- *What are two common Dive Mode alarms programmed into most dive computers?*
- *What will most dive computers tell you while in Surface Mode?*
- *What will your computer tell you while in Log Mode?*
- *What one feature is most essential to safe dive computer operation?*

Dive Mode: In Dive Mode, just about any computer you buy is going to tell you at least four things. These are:

- Your current depth.
- The deepest depth reached during the dive.
- How long you have been down.
- How long you can remain at your current depth before reaching the no-decompression limit.

In so far as nearly any computer you can buy these days will track exposure to both air and Nitrox, most will also display a reminders of the concentration of oxygen you have programmed into it, plus the *partial pressure of oxygen* (*PO2*) at your current depth, when using this mixture.

By default, most computers are programmed to set off an audible or visible alarm if you exceed the recommended PO2 limit of 1.4 atmospheres. You may be able to program this and other alarms as well.

One of the most important alarms your computer has will display or sound if you exceed a recommended ascent rate — typically 10 m/30 ft per minute or less, depending on depth.

Most computers also have a bar graph that provides a visible representation of the percent of your no-decompression limit you have consumed. A second bar graph may also show how much of your theoretical oxygen exposure limit you have used as well.

Surface Mode: In Surface Mode, most computers will tell you how long you have been out of the water and, possibly, how long until any residual nitrogen will leave your body. A particularly valuable feature when in Surface Mode is a *Time to Fly* indicator, which displays the time remaining until you can safely ascend to a cabin pressure of 2,400 m/8,000 ft.

Log Mode: Your dive computer will also have a Log Mode that will display depth, time and other data for your past several dives. This is particularly valuable when it comes time to enter information in your log book.

A standard or optional feature on many dive computers is a PC interface, that will allow you to upload a staggering assortment of dive log data to a personal computer. This makes logging dives even easier.

Owner's Manual: Among the most important feature of any dive computer is the owner's manual. Dive computers are not necessarily the most intuitive

of devices to use, and functions and procedures can vary widely from one model to another.

> You should never use any dive computer without first reading and thoroughly understanding the owner's manual. There are no shortcuts; you must read the manual in order to use the computer safely.

Since you don't want to have to read a complete owner's manual every time you use a new dive computer, it makes sense to simply buy your own. Dive computers are more affordable than ever. They have become like masks, snorkels and fins — personal dive equipment no scuba diver should be without.

Using Your Computer at Altitude

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is the threshold for altitude diving?*
- *What do you have to account for if you dive within twelve hours of arriving at altitude?*
- *What must you do to use your computer at altitude?*

Altitude diving is defined as diving at altitudes of 300 m/1,000 ft or higher. Altitude diving requires special procedures. When driving to a dive site more than 300 m/1,000 ft higher in altitude than where you came from, it is physiologically the same as if you had ascended from a recent dive.

Because you have gone from a higher to a lower pressure, you must account for residual nitrogen. Waiting twelve hours after arriving at altitude will allow you to proceed as though you are making the first dive of the day with a clean nitrogen slate. If you cannot wait the full twelve hours, you must proceed as though the first dive at the new altitude is a repetitive dive. Before using your dive computer at altitude, consult the owner's manual to see what special procedures you will need to follow.

Using Computers Safely

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are some general safety rules that apply to dive computer use?*

While a computer will add to the safety and enjoyment of your dive, it does not relieve you of the responsibility to dive intelligently.

- Read and thoroughly understand the manual. Follow the safety guidelines it provides. If you have questions or don't understand something, ask your instructor for help.
- Don't exceed your computer's maximum ascent rate, and never ascend faster than 10m/30 ft per minute.
- Don't *bounce* or *yo-yo* dive. This means making multiple ascents and descents on the same dive.
- To maximize bottom time and increase safety margins, always move from deep to shallow. Make your deepest dives of the day first, and do the deepest portion of each dive first.
- Do not exceed recommended depth limits. The maximum depth for new divers is 20 m/65 ft, unless under instructor or divemaster supervision.

- Remain well within your computer's no-decompression limits. When diving in cold water, reduce your dive time even further. Statistics show that divers who suffer DCS are usually pushing dive table or computer limits, making multiple dives per day, doing multiple days of diving, or exceeding recommended ascent rates.
- Recreational diving is no-decompression diving. You should always be able to ascend directly to the surface without making a *mandatory* decompression stop. Planned decompression diving requires special training and equipment.
- Make a safety stop at 3-6 m/10-20 ft for three minutes or more on every dive. (Or follow your computer's recommendation.)

- If you inadvertently exceed an NDL and your computer goes into decompression mode, follow the computer's mandatory decompression depth and time schedule as long as your air supply allows it. If you exceeded an NDL by more than five minutes or miss a scheduled decompression stop, do not enter the water again for a minimum of 24 hours.
- Don't share a computer with a buddy. Each diver should have a computer because even though you are diving together, your dive profiles are never exactly the same.

Computer Diving Procedures

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are some basic guidelines for using dive computers safely?*

Before Entering: Even though your computer should activate automatically on descent, activate it manually before entering the water to ensure it is functioning properly and set correctly.

Access your computer's Plan Mode to determine if sufficient no-decompression time is available for your planned dive profile. You can maximize your available bottom time by making repetitive dives to the same depth or shallower than the previous dive.

During the Dive: Monitor your computer frequently during the dive. If your computer is mounted in your console, don't allow it to drag along the bottom or bump into rocks.

Ascents: During ascent, hold the computer at eye level so you can monitor ascent rate, depth, and

time. During safety stops, hold the computer at chest level while maintaining a depth of 3-6 m/10-20 ft.

Repetitive Dives: A *repetitive dive* is any dive made within twelve hours of a previous one — or any dive made before your computer shows you have completely desaturated. In Surface Mode your computer estimates your body's declining residual nitrogen levels and uses this information to calculate available no-decompression limits for subsequent dives.

Flying After Diving

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What procedures must your follow before flying (or driving to altitude) after diving?*

When flying or driving to altitude after diving, the residual nitrogen remaining in your system from prior dives can cause decompression sickness unless allowed to sufficiently off gas.

Commercial airliner cabins are pressurized to altitudes of about 2,400 m/8,000 ft. Safe diving standards require a twelve-hour surface interval between your last dive and flying or driving to altitudes over 300 m/1,000 ft.

If you have made repetitive dives or multiple dives over multiple days, you should be even more conservative. Experts recommend in this case that you wait at least 24 hours before flying.

Dive Tables

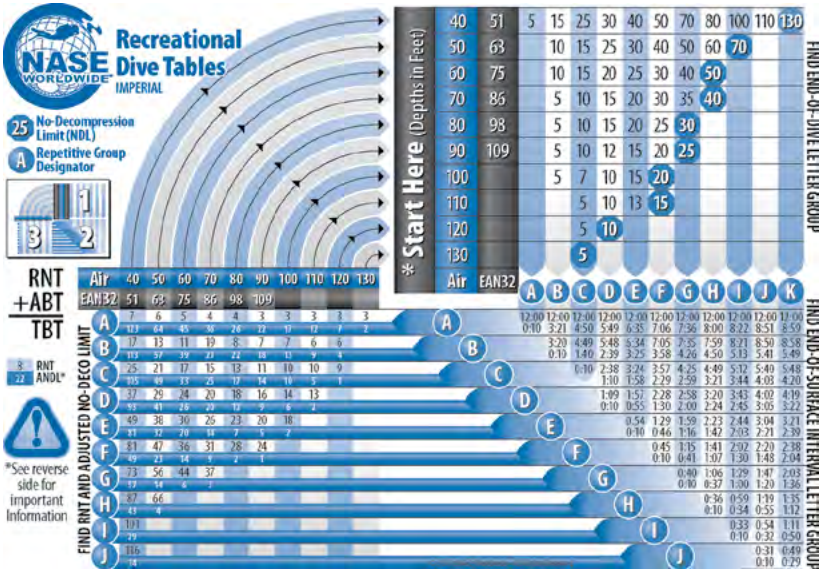
What to Look For

As you read through this section, highlight or underline the answers to the following:

- *How do recreational dive tables differ from US Navy dive tables?*
- *What must you do in order to dive using tables?*

As you read in Unit Three, if you don't have a dive computer, you will need to monitor depth and bottom time using a depth gauge and timer. You will use this information, in conjunction with dive tables, to plan your dives.

Some of the most widely used recreational dive tables are based on US Navy dive table data. The NDLs of these tables have been further modified using data obtained from microbubble formation studies conducted with Doppler ultrasound equipment.



Learning to use dive tables can be best accomplished by working directly with your instructor.

Odds and Ends

There are several subjects that, while important, haven't fit neatly into the broader topic areas we've covered thus far. As you are nearly done with the book, now is the time to cover them.

Logging Your Dives

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What can dive logs be used for?*

You would most likely *not* go to a job interview armed with just your diploma, as employers will be more interested in your accomplishments since graduation. That's why you have a resume. By the same token, you don't want to show up for a dive with just your certification card. Dive operators will

want to see where you have been diving, how often and how recently. That's where dive logs come in.

Dive logs can perform several important functions, such as:

- *Record and verify experience level:* Many dive operators require proof of experience before allowing you to participate in certain dives. If you should decide to go on to acquire a professional diving rating, logged diving experience will be one of the required prerequisites.
- *Track pertinent diving information:* As you gain experience, you will want to keep track of improvements in gas consumption and other factors. Experience may also enable you to reduce the amount of weight you need for a particular combination of exposure suit thickness and salinity. Your dive log can help you record this.
- *Reference information about a previous dive or dive site:* Water temperatures, depths, locations of interesting things to see, etc.
- *Demonstrate pride in your accomplishments:* Keep your dive log with your diving equipment and make log keeping an active part of your diving experience. You will find it to be fun and rewarding.

Your instructor will cover how to use the NASE dive log during your open-water training dives. During those dives, you will record a variety of information about them.

Underwater Navigation

What to Look For

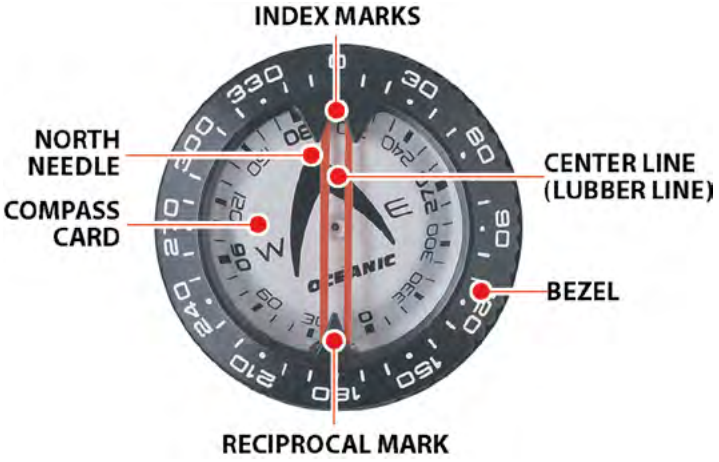
As you read through this section, highlight or underline the answers to the following:

- *What are the steps to follow when using a compass?*

To find their way under water, divers rely primarily on *natural navigation*. That is, following natural features such as a reef line or bottom contour.

Occasionally, though, divers face navigational challenges that natural navigation alone can't solve. That's where compasses may come in handy.

- Parts common to all compasses include: a *north needle*; a *center line* (*lubber line*); a rotating *bezel* (or *index marks*).



- To set your compass at the surface: point the center line in the intended direction of travel; and, match the index marks to the north needle.
- To swim a compass course under water: match the north needle to the index marks; and, hold the center line in line with your body and swim in that direction. Remember that you must hold your compass level in order for it to work accurately.
- A *reciprocal* heading is 180 degrees from the heading you set on the surface; most newer compasses have reciprocal index marks you can use to swim a reciprocal course.

Dive Flags and Floats

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is the chief function of dive flags?*
- *What regulations take precedence regarding dive flags?*
- *What are the two primary types of dive flags?*
- *What rules do you need to follow when towing a dive float?*

When diving in areas with boat traffic, it is important to be able to warn boaters and other watercraft that divers are present. This is what dive flags do. Dive flags fall into one of two types:

- In the USA and some adjacent regions, the most common dive flag consists of a white, diagonal stripe on a red background.
- Internationally, most divers rely on the Alpha flag, a blue-and-white pennant with a dovetailed edge.

Laws pertaining to dive flag use will vary by region; however, as a general rule, vessels are required to remain at least 60 m/200 ft away from a dive flag, and divers must surface within 30 m/100 ft. Be aware, however, that local laws and regulations take precedence.

When diving from a boat, you generally fly the appropriate flag from a staff on the boat. Absent a boat, the standard procedure is to fly the flag from a float which divers either anchor to the bottom or tow.

In addition to serving as a means to fly dive flags, larger floats can be used for surface support or storing fish and other game, spare weight or other items.

When towing a float, use a reel designed specifically for that purpose. Hand carry this reel; avoid clipping or tying it to your harness or other equipment.

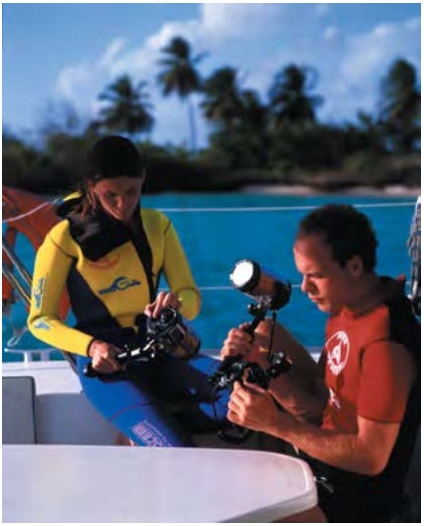
Diving and Your Health

In general, anyone in reasonably good health can dive. There are, however, some health issues that should be resolved by a physician before you dive. These may include:

- Cardiopulmonary problems involving the heart and lungs.
- Circulatory illnesses and high blood pressure.
- Asthma, chronic hay fever and other allergies.
- Any condition that could lead to loss of consciousness under water.

This is why it is important to complete the medical history form you received at the beginning of this course honestly and accurately. In most cases your physician can clear you for diving without any problem. In the few cases

where he or she can't, it is best to know before you place yourself in a situation where you may be injured.



Certain things are just common sense. You should not dive after consuming alcoholic beverages in any quantity or taking drugs, both prescription or otherwise (unless your physician okays it). Most dive operators will not allow you to continue diving after you have had your first alcoholic beverage for the day. Plan your activities accordingly.

Smoking before diving raises carbon monoxide levels in the blood. This can diminish your body's ability to use oxygen. Smoking is a bad idea in general — and especially bad if you dive.

Standard Safe Diving Practices

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What are the standard safe diving practices?*

At the conclusion of the course, and prior to being certified, your instructor will have you read and sign the NASE Standard Safe Diving Practices Agreement. By doing so, you will acknowledge that you understand and agree to follow the rules that help keep divers safe. Among these rules:

- Obey all local diving laws and regulations, including fish-and-game and dive-flag laws.
- Maintain good mental and physical fitness for diving. Do not dive when under the influence of alcohol or drugs.
- Engage only in diving activities consistent with training and experience. Keep proficient in diving skills. Maintain or renew proficiency and skills through continuing education. Be familiar with dive sites. Attend a local

orientation of the site before diving. Monitor diving conditions. If conditions deteriorate, postpone diving or select an alternate site.

- Use the buddy system. Plan dives beforehand with a buddy. Go over communications, procedures for reuniting in case of separation, and emergency procedures. Use tested, safe, familiar equipment. Inspect equipment for correct fit and function. Do not let uncertified divers use your equipment. Use a buoyancy control device, depth gauge, and submersible pressure gauge. Have an alternate air source and a low pressure buoyancy control inflation system.

Acknowledgment of Safe Diving Practices and Release After Training

- Use a boat, float, or other surface support station when appropriate. Keep weights clear of obstruction for easy removal. Establish buoyancy when in distress while diving.
- Know how to use a dive table or dive computer. Monitor depth and time under water. Limit maximum depth and time to level of training. Ascend at a rate of not more than 10 m/30 ft per minute. Listen carefully to dive instructions and follow the advice of dive supervisors.
- Do not hyperventilate when breath-hold diving. Avoid overexertion while in and under water. Know diving limitations and stay within them.

Finally, you will want to follow NASE's six cardinal rules for safer scuba diving (these are the ones you will need to commit to memory). We discuss these rules in Unit Five.

Special Concerns for Female Divers

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What is the only special rule that applies to female divers?*

Obviously, women differ physiologically from men; however, these differences generally have little impact on diving.

- As you already know, due to the larger ratio of surface area to body mass, women may be *slightly* more susceptible to cold than men.
- In so far as women tend to carry slightly more adipose (fatty) tissue than men, there is also a *slight* increase in the risk of decompression sickness for women.
- Menstruation, on the other hand, has virtually no impact on diving, and is no reason to stop.

The chief area of concern for female divers is pregnancy. There has been little medical research on the effects of pressure and elevated nitrogen levels on developing fetuses. For this reason, it is best if you do not dive while pregnant or attempting to become pregnant.

If you go diving and later discover you were pregnant while doing so, don't panic. The experience of women who have been diving while pregnant suggests there is little risk. Nevertheless, make your doctor aware and discontinue diving until after your baby is born and your doctor says it is okay to resume diving.

Continuing Education

What to Look For

As you read through this section, highlight or underline the answers to the following:

- *What continuing diver education opportunities exist for divers once they get their entry-level certification?*

Very few people who are serious about becoming active divers and getting the best possible return on their investment in learning to dive settle for just a beginner certification. Smart divers build on their knowledge and skills by diving actively and taking part in continuing education.

NASE offers an ever-increasing number of advanced, specialty and leadership courses designed to help divers achieve these goals. Popular continuing education courses include:

Nitrox Diver

You've already read about Enriched Air Nitrox (EANx), the oxygen-rich gas mixture that can give you longer bottom times, shorter surface intervals and greater safety margins. The Nitrox Diver course teaches you how to use EANx safely, and is most likely the very next course you should take.

Learning to use Nitrox takes little more than self study and a few minutes with your instructor. You can complete the course on line — starting right now, if you want.

Advanced Open Water Diver

Admittedly, the name may be a little misleading (Master Scuba Diver is NASE's "real" Advanced course). Nevertheless, this two-day program will more than double the amount of in-water training your receive during the Open Water Diver course and introduce you to a number of specialty diving activities. It will also increase your depth rating to 30 m/100 ft.

For the most part, though, the Advanced course is about learning how to have fun under water. There is little self study and virtually no classroom or pool time. The course consists primarily of just getting out and diving with your instructor.

The Advanced course takes just two days. You can complete it the weekend after becoming certified — or the next two days after becoming certified, for that matter.

Rescue Diver

Although the Open Water Diver course provides a limited introduction to self rescue and other forms of diver assistance, there is neither the time, nor are beginning students truly ready to learn comprehensive dive rescue skills.

The Rescue Diver course provides this training, and comes at a time in the learning continuum when students are truly ready to learn. It helps meet an important prerequisite for leadership training as well.

Specialty Diver Training

Specialty Diver courses are designed to build on the foundation you obtained in your Open Water, Advanced Open Water and Nitrox Diver courses. They enable you to custom-tailor your training to meet your unique interests. Popular Specialty Diver courses include;

- Night Diver.
- Deep Diver.
- Underwater Navigator.
- Underwater Imaging (photo and/or video).
- Wreck Diver.

The number of available Specialty Diver courses grows all the time. Check with your instructor to see what he offers.

Master Scuba Diver

Where the Advanced Open Water Diver course is a more-advanced *Open Water* (i.e., beginner) dive course, for those serious about diving, the NASE Master Scuba Diver program is the "real" advanced course. The Master Diver course covers a broad range of topics and skills, and provides students with a comprehensive understanding of dive physics, physiology, equipment and more. The dives and skills are equally as challenging.

If you are planning to progress to leadership training — or you simply want to be the best diver possible — this course helps you meet an important prerequisite.

Leadership Training

If you'd like to share your love of diving with others, you can.

- If you would like to learn how to organize and conduct dives for certified divers, and assist instructors with classes, you will want to become a certified Divemaster.

- The Assistant Instructor course builds on your Divemaster training, teaching you how to plan and conduct academic, confined- and open-water teaching presentations. Certified NASE Assistant Instructors can even conduct some specialty and other programs independently of their instructors.

- The final step is to become an NASE Open Water Instructor. As such, you can conduct a wide range of NASE courses.

Congratulations…

You've completed Unit Four. Don't forget to go back and complete the Study Questions for this unit before proceeding to Unit Five.

Unit Five

Diving Skills

Everything you have seen, heard, read and studied up until now has been leading to this: *Actually getting in the water and going diving.* Unfortunately, you can't master the skills of diving by reading a book, watching a video or going through an online course. The only way this can happen is by getting wet and working with a qualified instructor.

In confined water, your NASE Worldwide Instructor will demonstrate and then have you practice over three dozen different skills. You will then apply these skills on three or more open-water training dives. Some of these skills, such as inflating or deflating a BC, are components of larger skills, such as buoyancy control. Others, such as entries and exits, are complete skills in and of themselves.

What we *can* do, in this section, is give you a preview of some of the more important or more complex skills you will learn. Again, simply reading about these skills won't help you form a complete mental picture. It will, however, facilitate the process of learning.

What will be particularly valuable is if, after being introduced to these skills in confined water, you come back and review this section a second time. You will discover that, after actually having done these skills, the information you will find here has much more meaning.

The Six Rules of Recreational Scuba

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

- *List the Six Rules of Recreational Scuba and make them an integral part of how you learn and perform scuba skills.*

Throughout this section, we'll make reference to one or more of the Six Rules of Recreational Scuba. Each of these rules is integral in some way to how you perform the skills covered in this section. Although diving has a number of rules and guidelines, these are the six most critical to your safety and that of the aquatic environment.

6 *Dive like a fish* (and not like an ape). Strive to maintain a near-horizontal body position under water while swimming and resting. Avoid standing, kneeling or sitting on the bottom.

5 *Do not overweight yourself.* Always use the least weight possible. Check your buoyancy at the end of every dive by ensuring you can hover, motionless, at safety-stop depth with no air in your BC. Always establish positive buoyancy upon reaching the surface by at least partially inflating your BC.

4 *Continuously monitor depth, time and pressure.* Stay well within your planned limits for each.

3 *Ascend slowly.* Stay well within your dive computer's ascent rate and under no circumsances come up faster than 10 m/30 ft per minute. Always spend the last three to five minutes of every dive between 3-6 m/10-20 ft.

2 *Equalize early and often while descending.* Never go deeper than you can comfortably equalize.

...and the Number One Rule of recreational scuba diving:

1 *Breathe continuously while on scuba.* Never hold your breath.

Dive Like a Fish

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

- *Maintain a near-horizontal body position while swimming and resting under water.*
- *Perform a variety of common scuba skills while avoiding contact with the bottom.*

Fish evolved eons before the most primitive vertebrates crawled on land. Over time they have developed many characteristics that make them ideally suited for life under water. Fort example:

- Fish are streamlined, allowing them to move through the water with minimal effort.
- Most fish seldom — if ever — make contact with the bottom. And, in so doing, they cause little damage to themselves or their environment.

- Fish maintain a perpetual state of neutral buoyancy and a nearly horizontal body position, regardless of whether they are swimming or not.

Divers can achieve much by emulating these characteristics. In contrast, an animal you *would not* want to emulate under water is an ape. Consider:

- Apes walk (mostly) upright. This is hardly what one could call streamlined.
- Apes shuffle their feet and drag their knuckles. Under water, this would cause damage to the environment and stir up silt and sediment — ruining the visibility for themselves and everybody else.
- When it comes to neutral buoyancy, apes *haven't got a clue*.

Now you see the reason for Rule Number Six: *Dive like a fish* (and not like an ape).

As you learn the important skills of scuba diving, strive to do them *as a fish would*. That is while:

- Maintaining a near-horizontal body position.
- Minimizing or avoiding contact with the bottom.
- Maintaining neutral buoyancy.

Divers frequently swim over silty bottoms and fragile coral reefs. If you find yourself needing to clear a mask, recover a regulator, share air or adjust buoyancy, you can't always just settle to the bottom first. That's why it is important to be able to do these and all other critical skills while maintaing depth and avoiding contact with the bottom.

Scuba Unit Assembly

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

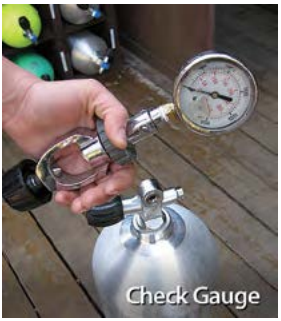
- *Correctly assemble a scuba unit consisting of a tank, BC and regulator system.*
- *Correctly disassemble a scuba unit when finished.*

Before you can go scuba diving, you have to be able to put your scuba unit together. This will be one of the first skills your instructor covers with you — possibly before you even go to the pool (or whatever body of confined water your instructor uses).

The first step is to make sure you have everything you will need. This list will include:

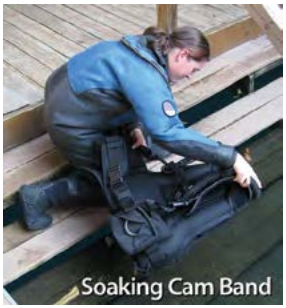
- A scuba tank.
- A BC.
- Weights for your weight system.
- A regulator system with all of the components identified in Unit Three.

Among the first things you will want to do is to make certain your tank is ready to go.


Check Gauge

This is a good time to learn to identify the hydrostatic test date and visual inspection decal, making sure they are up to date.If your tank has a yoke-style valve, inspect the O-ring, replacing it if it appears worn or damaged. If you have access to one, a small, hand-held "check gauge," make sure the tank is sufficiently full, before putting everything else together.

Another thing you will want to do, if possible, is soak your BC's cam band (tank band) in water, so it will stretch. This will help prevent it from coming loose later.


Soaking Cam Band

If need be, attach second stage mouthpieces to your regulator system. (Your instructor will show you how.)

When you are certain all of the components are ready to go, it is time to put everything together. When assembling a scuba unit, it is easy to become confused as to which direction is up, and what is right and what is left. A good way to avoid this confusion is to orient your equipment as though you are dressing an invisible diver who is standing in front of you, with his or her back to you. This way, your right will be the diver's right, and your left, his or her left. (See illustration on page 111.)

Stand the scuba tank up so that the valve orifice is facing *away* from you, and the valve turnwheel is on your right. Remember that, from this point on, you *don't* want to leave the tank standing upright, unattended. Once you start attaching BCs, regulators and, in particular, weight systems, it will be even more likely to fall over. If you need to step away momentarily, lay the tank on its back, BC up (if attached).

Checking Tank Height

The next step is to slide the BC over the top of the tank, and let it slide down into position. How high up should the BC be? Ultimately, you can only discover that through experimentation.

You want the tank high enough so that, if possible, you can reach back and grab a a second stage hose — but not so high that the regulator first stage is constantly hitting you in the back of the head. As a starting point, try having the top of the BC even with where the tank body meets the valve.

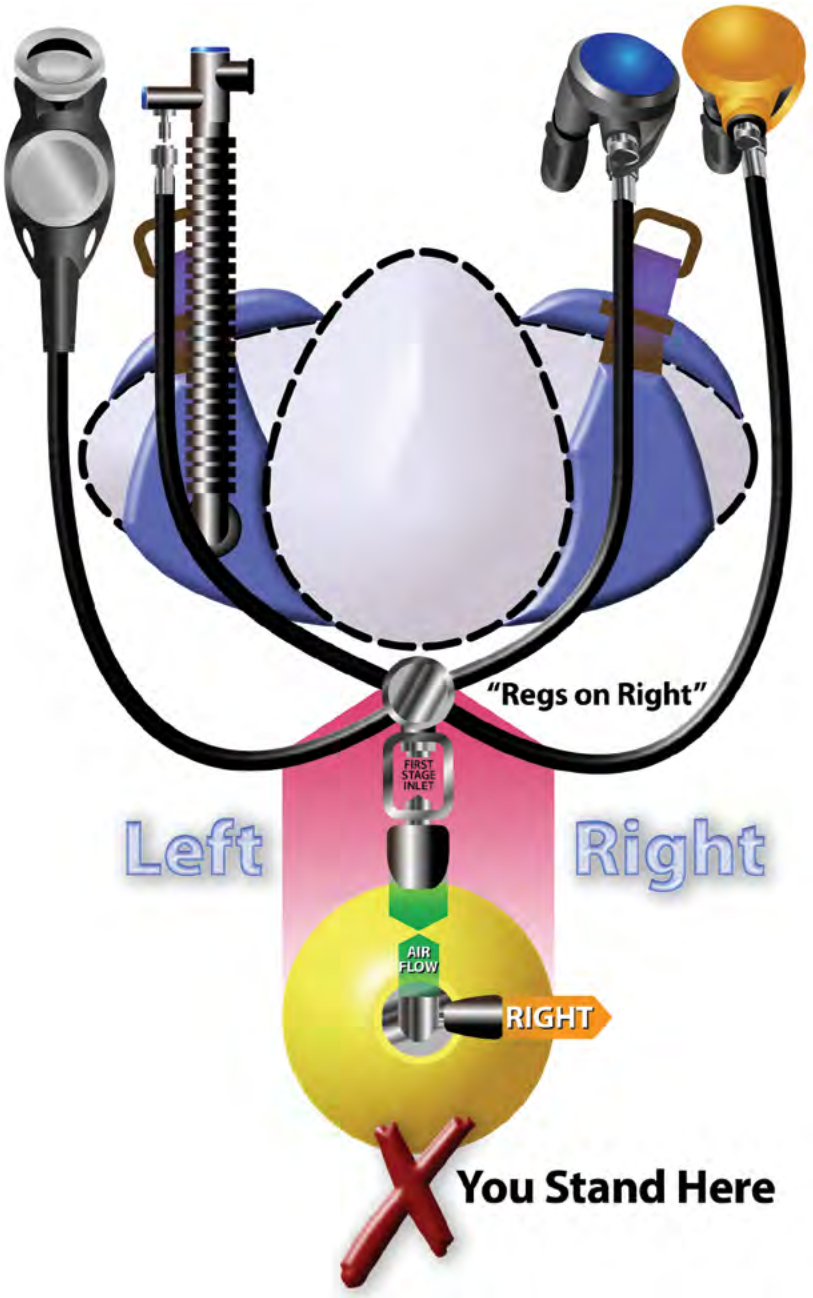
Some BCs have a *tank height adjustment strap* — an adjustable loop that goes around the neck of the tank to help ensure you position the BC at the same place every time.

Your instructor will show you how to tighten the cam band or bands. After doing so, you will want to check to make sure the band is sufficiently tight. You will sometimes see divers pick up their BCs at this point, and shake them up and down to see whether the tank is secure. As you can imagine, this can lead to severely bruised (or broken) toes.

As an alternative, simply reach down, take the cam buckle firmly in hand, and try sliding it up and down along the tank. If it doesn't move — or it moves very, very little — the cam band is most likely tight enough. If you are able to move the cam buckle up and down, however, you need to tighten it again.

Now you are ready to attach the regulator. Start by removing the dust cap from the first stage. If your first stage has a DIN connector, inspect the O-ring for damage or wear, and replace if needed.

Orient the first stage so that the yoke screw or DIN connector is pointing towards you. While holding the connector in this position, rotate the first stage body so that the high-pressure (console) hose is on the left. If the low-pressure hoses are on a rotating turret, turn them so that the second stage hoses are on the right.


"Regs on Right"
FIRST STAGE INLET
Left
Right
AIR FLOW
RIGHT
You Stand Here

Now mate the first stage inlet to the valve outlet. Make sure everything is properly aligned. Now turn the yoke screw or DIN connector until it is just finger tight.

Before pressurizing the regulator, connect the low-pressure inflator hose to the BC power or alternate-air-source inflator. Your instructor will show you how.

Now, while holding the submersible pressure gauge facing *away* from you, open the valve turnwheel counter-clockwise one quarter turn, or until you hear air start to flow. What you should hear at this point is the regulator pressurizing itself. If, instead, you hear air escaping, either the regulator first stage isn't properly seated or something else is wrong. Turn the valve *off* (clockwise) and fix the problem before continuing.

If the regulator pressurizes successfully, check the SPG to make sure you have sufficient gas (your instructor will tell you how much this should be). If need be, switch to another tank with more air or Nitrox. Assuming you have sufficient gas, go ahead and turn the valve all the way on.

You will frequently hear divers say that you should turn your valve all the way on, then back a partial turn. There is no reason to do this. As long as you don't force the turnwheel in either direction, there is no more harm in turning the valve all the way on than there is in turning it all the way off.

The danger in turning the valve back a partial turn is that you may accidentally turn it all the way *off*, then open it a partial turn. At the surface, this could appear to give you adequate gas to breathe; under water, however, a partially open valve could leave you starved for air. To avoid this, simply turn the valve either all the way on, or all the way off.

The next step is to test the regulator for function. Start by momentarily depressing the primary second stage purge button. This will blow anything that shouldn't be inside the second stage out. If the regulator begins to *free flow* when you depress the purge button, don't panic. Simply place a finger in the mouthpiece. The air flow will stop.

Now take several breaths from the second stage while watching the submersible pressure gauge. The regulator should be nearly as easy to breathe from as breathing normal air, and the pressure gauge should hold its reading and not fluctuate.

If the regulator does not breathe easily, alert your instructor. If the pressure gauge drops or fluctuates, it means you have accidentally turned the gas all the way off or it is only open a partial turn — a problem that is easily fixed. Assuming the primary second stage checks out okay, repeat the process with the alternate air source.

Secure the alternate air source second stage in its holder and clip the instrument console off to one of the D-rings on the front of the BC. If it will be some time before you actually get in the water with the unit (say, the length of a boat ride), turn the air off so that it doesn't accidentally leak out during the ride. Just remember to turn it on again before entering the water.

As a final step, insert any weights or weight pockets. (The first time out, your instructor may have you wait to do this until after you get in the water.)

Before leaving the unit unattended, either lie it down on its back (*not* on the BC), or secure it in a proper storage rack.

Scuba Unit Disassembly

Scuba unit disassembly is largely just the reverse of the assembly process. The main thing is to remember to *completely* depressurize the regulator system by turning the air off and depressing one of the second stage purge buttons before you attempt removing the regulator.

If you've used the unit in salt water and have access to a garden hose or shower head, rinse the unit in a *gentle* stream of fresh water before disassembly.

Donning Mask and Fins

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

- *Correctly don a scuba mask.*
- *Correctly don scuba fins.*

Just as you can't go scuba diving without first putting together your scuba unit, you can't go scuba or free diving without first donning your mask and fins.

Donning Your Mask

Depending on circumstances, you may put your mask on out of the water, in the water — or even, as we will discuss later on in this section, *under* water. Wherever you do it, however, the same principles apply.

Most of us, instinctively, tend to put masks on by placing the strap in back of our heads, then pulling the mask down into position. If this method works, there is nothing wrong with it...other than the fact that it tends to pull hair down onto your face and trap that hair under the top edge of your mask skirt, where it can cause leaks.

The *better* way to don a mask is to pull the mask strap in front of the lens, put the mask on your face, *then* pull the mask strap over the back of your head. Not only will doing so reduce the likelihood of hair getting trapped under the skirt, it generally helps ensure a better fit.

As you read earlier, if you wil be wearing a hood, don the hood first, then pull the hood down around your neck. Now don your mask in the normal fashion and pull the hood up and over the mask strap. This not only helps prevent the mask skirt from getting caught on the edge of the hood, it helps prevent mask loss.

If circumstances dictate that you must wear a snorkel on your mask (such as when free diving in cold water), you pretty much have to wear the mask strap on the outside of the hood. This means you will need to be especially careful when donning the mask, making sure the mask skirt rests on skin and not neoprene.

Donning Fins

Most of the time, you put your fins on *before* entering the water. The few exceptions would include gearing up in the shallow end of a swimming pool, or entering from a shallow beach in calm water. As with mask clearing, however, the same principles apply, regardless of where you don your fins.

If your fins have spring heel straps, or straps that are not easily adjustable, there is little you can — or generally need — to do, other than to pull the strap down out of the way before putting the fin on. The stock heel straps on most fins can be tightened simply by pulling on the ends of the straps. If your fins are like this, loosen the straps before you don them. If your fins have quick-release buckles, make sure they are re-fastened before you put the fins on.

The best way to don fins, whether sitting or standing, is to assume a *Figure 4* position. That is, keeping one leg straight while putting the ankle of the other leg on top of the opposing knee.

If you are standing, you are going to need to hold on to a buddy or other solid object for support (if donning fins in chest deep water, the water itself may hold you up). Trying to imitate a stork while putting on fins is an invitation to disaster. Sooner or later, you are going to lose your balance and fall over. This is especially dangerous when wearing scuba equipment.

Once in the *Figure 4* position, grab your fin by the *side* of the foot pocket and steer the pocket on to your foot. *Do not* attempt to pull the fin on by the heel strap. If you do, you will have difficulty getting it on straight.

Once your fin is in place, pull the heal strap up into position and, if need be, pull the strap tight. In doing so, try to keep the straps even on each side.

Once your fins are on, avoid walking around in them out of the water. If you must do so, walk sideways or backwards. Out of the water, scuba fins are like clown shoes — and you are going to look like a clown if you attempt to walk forward and end up tripping over them.

Regulator Recovery and Clearing

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

- *Remove, replace and clear a regulator second stage of water, then resume breathing while maintaining airway control.*
- *Recover a regulator second stage that has fallen behind the shoulder, using the reach and sweep methods.*

Breathing from a regulator isn't difficult. You stick the regulator in your mouth. Breathe in. Breath out. Repeat as necessary — just don't forget Rule Number One: *Breathe continuously while on scuba*. Never hold your breath.

What this means is that, any time the regulator is out of your mouth under water, the only way you can continue to breathe is to exhale. This is why you want to develop the habit of making a continuous "Ahh" sound whenever you don't have a regulator in your mouth. Doing so will not only help ensure you are exhaling, it will help prevent you from exhaling *too* forcefully or fast (which can be every bit as bad as not exhaling at all).

There are many possible reasons why you might find yourself without a regulator in your mouth, or needing to find your regulator and put it back in.

- While floating at the surface, your regulator second stage may have fallen behind your shoulder. You will need to be able to find it so that you can have something to breathe from when you descend.
- Although uncommon, it remains possible for a regulator to be knocked out of or pulled from your mouth under water.

- Your second stage mouthpiece may be held in place by little more than an inexpensive plastic cable tie. These sometimes break, causing the regulator to come out of your mouth while the mouthpiece remains in place.
- Sharing air with another diver will entail one or both of you taking a second stage out of your mouth under water and replacing it with another one.

Ironically, the place you are most likely to need your regulator recovery and clearing skills are right here in your beginning scuba course. Scuba classes involve a number of skills, such as gas sharing and BC oral inflation, that involve removal and replacement of a regulator second stage under water.

Regulator Clearing and Airway Control

When you take a regulator out of your mouth under water, it will at least partially fill with water. This means you can't simply put the mouthpiece back in your mouth and inhale (unless the thought of breathing water appeals to you).

Fortunately, as long as you have air in your lungs, all you need to do is put the second stage back in your mouth and exhale. Doing so will cause most or all of the water to exit the second stage through the exhaust valve and allow you to resume breathing.

The only thing you need to be aware of is that clearing a regulator by means of the exhalation or "blast" method may not succeed in getting all of the water out. Therefore, you need to make the first inhalation a cautious one. This will allow you to "breathe past" the remaining water and inhale successfully. A sharp exhalation will then clear the remaining water. This is called *airway control.*

But what if you do not have sufficient air remaining in your lungs to clear your regulator? *No problem*. Your regulator second stage will have what is known as a *purge button* (although these days this is more likely to be just a flexible area on the front of the second stage, and not an actual button). Depressing the purge button will allow air from your scuba tank to clear the water for you.

Your instructor will have you practice both methods.

Regulator Recovery

If you are following Rule Number Six ("Dive like a fish, not like an ape"), and your regulator comes out of your mouth under water, it will generally just hang down over your right shoulder, where you can easily see and recover it. Occasionally, such as during ascents and descents, you may be vertical in the water. If you lose your regulator under these circumstances, it *may* find its way behind you, forcing you to hunt for it.

Bear in mind, your alternate-air-source second stage should be properly secured in the triangular area between your mouth and the corners of your rib cage. So, if you really do lose a second stage, before wasting any time or air looking for it, you want to locate that alternate air source and begin breathing from it. Now you can take all the time you need to locate the missing primary second stage.

The next thing you want do to is to lean forward (getting back into your "Dive like a fish" position would be best), and dip your right shoulder. This by itself, coupled with the force of gravity, will usually cause the missing second stage to fall back into sight. If it does not, there are two different methods you can use to locate the recalcitrant mouthpiece.

Sweep Method: Your instructor will most likely have you practice this skill while in a kneeling position (if you stay in your normal horizontal position, you may have a hard time getting the second stage to do anything but hang out in plain sight). On his signal, you will take the regulator out of your mouth, begin exhaling small bubbles, and toss the second stage behind your shoulder.

- Before continuing, your instructor may have you begin breathing on your alternate air source second stage, so there is no risk of you running out of breath while searching for the missing regulator.
- The next step is to lean forward and dip your right shoulder. (Okay, this by itself may cause the missing regulator to magically reappear — but play along with us...okay?)
- Next, bring your right arm straight out in front of you. Then, while keeping your arm as close to your body as possible, bring your hand down and touch the outside of your right knee.
- Now sweep your arm as far back as you can. If possible, touch the side of your tank while doing so.
- Once your arm is as far back as it will go, sweep it outward and around to the front, as shown in the illustration.

These steps should be more than sufficient to snag the regulator hose with your right arm, and you should see it lying across your upper arm or shoulder. Nevertheless, if you need to, take your left hand and sweep it along your right arm, from your wrist to your shoulder. By doing so, you should be able to find a second stage that is still not within sight.

Reach Method: Many divers wear their tanks too low because they are afraid of hitting their heads on their regulator first stages. This is unfortunate for a couple of reasons:

- Wearing your tank too low tends to drive your feet down, making it harder to maintain proper body position and putting the coral or plant and animal life below at risk.

- Doing so also makes it harder for you to reach back and access your regulator hoses and valve, which is important for you to be able to do for safety.

Assuming you have set up your scuba unit correctly, you should be able to recover a regulator using the reach method without difficulty. To do so:

- Reach back over your right shoulder. If your regulator is set up correctly, your primary second stage hose should be the first one you feel.
- If you can't feel a hose, try reaching down with your left hand and pushing up on the bottom of the tank. This usually does the trick.
- Once you have the hose in hand, slide your hand along the length of the hose until you come to the missing second stage.

As your confined water sessions progress, your instructor will most likely have you practice these methods repeatedly, while swimming, hovering and floating on the surface.

The Best Solution is Prevention

Over the course of your scuba class, you will learn a variety of skills designed to help solve problems ranging from muscle cramps to being without air. Knowing how to deal with these situations is important — but it does not overshadow the fact the best "solution" to any problem is to *never* let it happen in the first place.

Regulator recovery and clearing is no exception. There are a number of steps you can take to minimize the likelihood of your ever having to hunt for a missing second stage.

- If you are using your own mouthpieces on a rental or teaching regulator system, make sure they are held securely in place with a cable tie or manufacturer-supplied mouthpiece clamp. A cable tie can still fail, and can still cause you to lose a second stage. This is less likely to happen, however, than if you have nothing securing the mouthpiece at all.
- Get in the habit of keeping your second stage hose draped over your right shoulder when on the surface, as there is less likelihood of it getting lost

this way. Better still, unless there is a pressing need to conserve air, simply keep your second stage in your mouth. This can help prevent a number of problems at the surface.

- If your mouthpiece comes out of your second stage under water, you can usually get it back in place. However, unless you have an extra cable tie with you, you should continue breathing from your alternate air source and terminate the dive. After all, if the mouthpiece came off once, it will very likely come off again, unless properly secured.
- Always secure your alternate-air-source second stage in a reliable holder. As you have seen, that second stage is as much for you as it is for an out-of-air buddy. You don't want to lose your primary second stage, only to discover that your alternate has gone missing as well.

Mask Clearing

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

- *In confined water, remove your mask, swim a distance of at least 15 m/50 ft using a tactile referemnce, then replace and completely clear the mask of water.*
- *In open water, remove, replace and completely clear a mask of water.*

In an ideal world, water would never get inside your mask, there would be world peace and every child would have a puppy. Well...don't hold your breath.

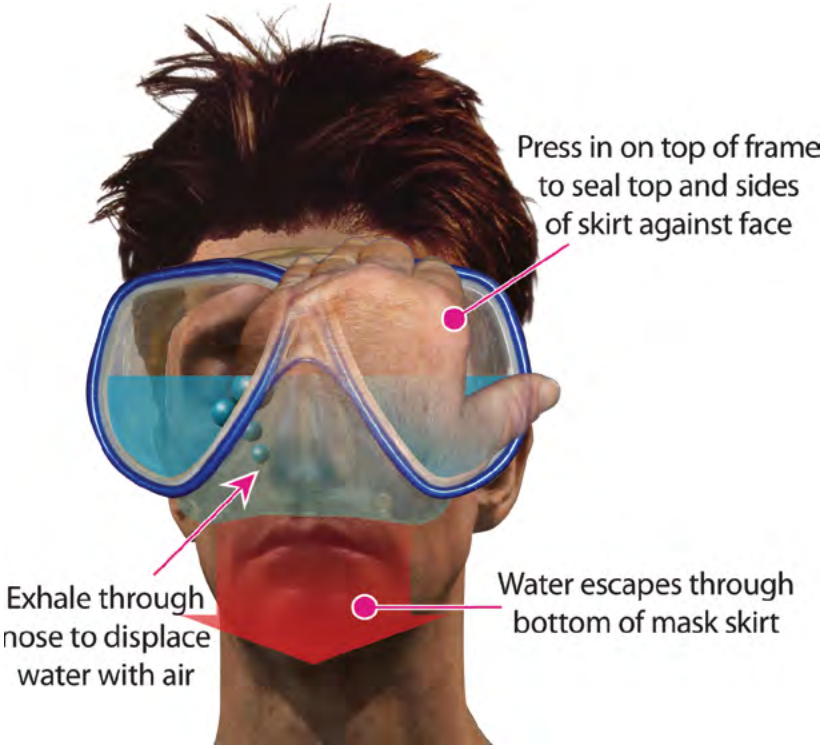
The fact is, given the right set of circumstances, water *will* get inside your mask — at least from time to time. The good news is, there is a simple technique that will enable you to get the water *out* of your mask, without having to return to the surface.

To best understand this technique, imagine you have an open jar with you under water. Turn the jar upside down so that the opening is at the bottom. Now exhale into it. What will happen?

The answer is that your exhaled air will rise to the top of the jar and force the water out the bottom.

This is what you need to do to get water out of your mask: Turn your mask into the equivalent of an upside-down jar, then exhale into it.

- The first step is to seal the top and sides of your mask, so that air can't escape and water can only come out the bottom. To do this, simply press in at the top of the mask frame.
- Now exhale out your nose, into the mask. The air will rise to the top of the mask and the water will go the only place it can: out the bottom of the skirt.


Press in on top of frame to seal top and sides of skirt against face
Exhale through nose to displace water with air
Water escapes through bottom of mask skirt

- As the last of the water leaves, look up, so that the very bottom of the mask skirt is the lowest point. This will help you get *all* of the water out.

The key to doing this skill successfully is being able to separate breathing in and out through your nose from breathing in and out through your mouth. The good news is that at least two thirds of all diving students seem to be able

to do this instinctively. Unfortunately, for the remaining third, mask clearing can be a real challenge.

Before you even go to the water, you need to find which group you fall into. To do this:

- Hold your hand in front of your nose and mouth, so that you can feel your exhaled breath.
- Open your mouth slightly.
- Attempt to inhale in through your mouth, then out through your nose.

If you can do this, odds are mask clearing will not be especially difficult for you. But what if you only seem to be able to inhale and exhale through both orifices simultaneously? *Don't panic*. Try this:

- As you inhale, hold your tongue against the back of your throat. You will likely discover you inhale only through your mouth.
- As you exhale, hold your tongue against the roof of your mouth. This will generally prevent air from escaping anywhere but out your nose. (Remember that, under water, you can also accomplish much the same thing by blocking your regulator mouthpiece with your tongue.)

You may master this technique quickly, or it may take some practice. Under any circumstance, *do not* take part in any in-water training until you do. Otherwise, learning to clear your mask will be neither easy or fun.

Of course, as with any potential underwater problem, the best "solution" is prevention. While you can't totally eliminate the possibility of needing to clear your mask, you can do a lot to reduce the frequency of that need.

- You can start by owning your own personal dive mask. Choose it carefully, ensuring not only a comfortable fit, but the best seal possible.

And, as we said earlier in this section:

- Learn to don your mask the right way: Pull your hair back, put your mask on your face — and only then put the strap on over your head. If you put the strap on first, you may end up pulling hair down under the mask skirt, causing leaks.
- If wearing a hood, pull the hood down around your neck, don the mask, then pull the hood up over the mask strap. This will help prevent the mask skirt from getting caught on the edge of the hood, causing leaks. (It will also help you avoid mask loss.)

This last point helps illustrate why it's a good idea to avoid wearing a snorkel on your mask unless absolutely necessary. Wearing a snorkel means you will

likely have to put the mask on *over* your hood, increasing the likelihood of leaks.

BC Use

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

- *Correctly inflate and deflate a BC on the surface and under water, using both oral and power inflation.*
- *Use a BC to help establish positive buoyancy on the surface and maintain neutral buoyancy under water.*

As you read in Unit Three, BCs are multifunction devices that serve a variety of purposes. In the water, we use BCs chiefly for two things:

- Providing positive buoyancy for swimming and resting on the surface.
- Compensating for exposure suit compression at depth.

Learning to use a BC for these tasks involves a variety of steps.

Familiarization and Visualization

Before you ever take a particular BC in the water, you need to know as much as you can about it.

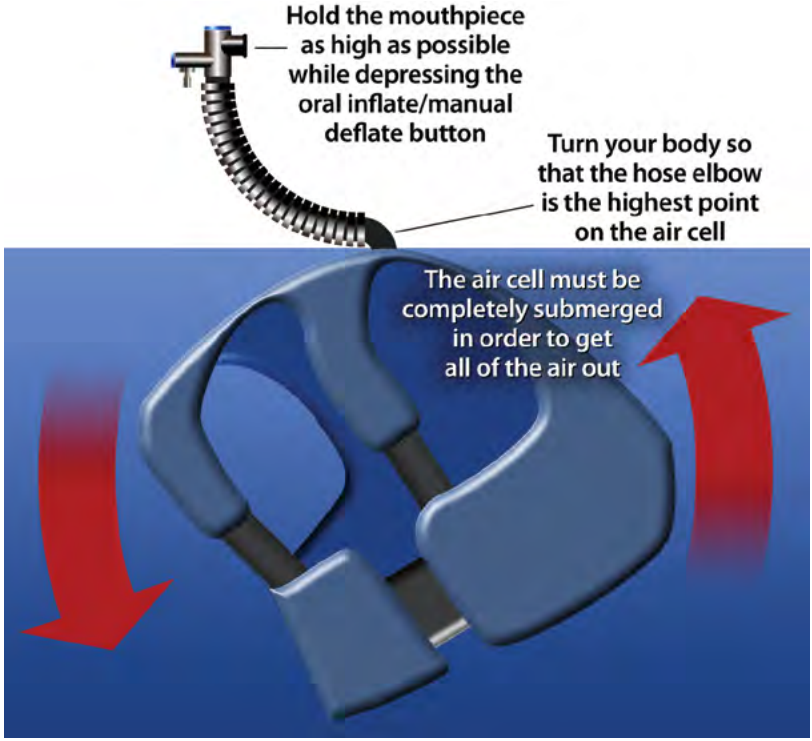
- Start with the power inflator mechanism. It will typically have two buttons. Depressing one will fill the air cell with gas from your scuba tank; the other will allow you to either orally inflate the BC or manually deflate it. Learn to identify the buttons by both sight and feel.
- Locate any additional exhaust points, such as the remote exhaust where the large-diameter inflator hose (airway) joins the air cell, as well as any overpressure valves with pull cords.

Next, you need to visualize how you will position yourself to effectively vent air under water.

- Hold the BC in front of you, in an upright position, such as if you were ascending or descending. Visualize how you would need to turn your body in order to make the various exhaust ports the highest point on the air cell.
- Repeat the procedure, only this time, hold the BC in a horizontal position, such as you would be in most of the time while under water. Again, think about how you would have to turn your body in order to make the various exhausts the highest point.

BC Deflation at the Surface

The first BC skill your instructor will likely have you do is simply getting all of the air out of the air cell so that you can go under water.


Hold the mouthpiece as high as possible while depressing the oral inflate/manual deflate button
Turn your body so that the hose elbow is the highest point on the air cell
The air cell must be completely submerged in order to get all of the air out

While you can do this in a variety of ways, the one your instructor will most likely focus on involves using the manual deflator button on the power inflator assembly.

You will most likely do this in chest-deep water, so the first thing you want to do is squat down so that the entire air cell is submerged. Turn your body so that the point where the airway connects to the air cell is the highest point. Now hold the airway up *above* this point and depress and hold the oral inflate/manual deflate button until *all* of the air is vented. Remember that air can only come out of the air cell if it is completely under water.

This is a skill you will repeat throughout the course, in water too deep to stand, and possibly using other deflation controls as well.

BC Inflation Under Water

As you descend, your wet suit will compress, causing you to lose buoyancy. To compensate and maintain neutral buoyancy, you will need to add air to your BC's air cell.

To practice this, your instructor will most likely have you start by lying face down on the bottom. Use the power inflator button to add air in small bursts, pausing each time to assess the net effect on your overall buoyancy.

If you are properly weighted, it won't take long before you find your body rising as you breathe in, and falling as you breathe out. Obviously, as soon as you achieve neutral buoyancy, stop adding air to the air cell.

Do not let go of the power inflator during this exercise. If you find yourself floating up, you need to be able to immediately vent some air from the BC, lest you float to the surface out of control.

Oral Inflation: All other factors being equal, using the power inflator to adjust buoyancy under water is preferable. It's easier, and it does not require that you remove your regulator.

Nevertheless, the possibility exists that your power inflator could malfunction and that, as a consequence, you might need to rely on oral inflation to get you back to the boat or shore.

A power inflator malfunction is most likely to occur in the form of an inflator button that sticks in the *open* position. As this could lead to a dangerously fast ascent, you need to be able to quickly disconnect the low-pressure inflator hose under water. Your instructor will likely cover this in a separate exercise.

Once the low-pressure inflator hose is disconnected, your only means of inflating the BC under water will be to do so orally. Your instructor will most likely have you practice this in much the same way as you learned to use the power inflator. This time, however, instead of pressing the power inflator but-

ton, you will take a deep breath, remove the regulator from your mouth, and exhale into the inflator while depressing the oral inflator button. A couple things to keep in mind:

- *Don't let go of the regulator:* As soon as you are done blowing air into the BC, you will need to take a breath. You don't have to hunt for the regulator to do so.
- *Remember Rule Number One:* As soon as the regulator leaves your mouth, start exhaling small bubbles by making the "Ahh" sound. Bring the inflator to your lips and continue exhaling into the BC.
- *Depress the inflator button fully:* If you don't, no air will go inside the BC. As soon as you are done exhaling into the BC, however, release the inflator button or the air will come right back out again.
- Don't exhale all your air into the BC: As with the power inflator, you need to add air in small increments to avoid over inflating the air cell. Additionally, you need some air left to clear your regulator.

The most important thing to keep in mind is that, unlike using the power inflator, simply exhaling into the BC will not change your overall buoyancy. Why? All you are doing at this point is shifting air from your lungs to the air cell. The change in buoyancy occurs when you put the regulator back in your mouth and inhale.

Inhale cautiously, noting the overall effect on your buoyancy. Be ready to vent air from the air cell if you find yourself rising.

BC Inflation at the Surface

Rule Number Five reminds you to always establish positive buoyancy upon surfacing. About the only exception to this is when you surface in water shallow enough to stand and can simply walk ashore.

Most of the time, all you need to do upon surfacing is depress and hold the power inflator button until your BC is about half full. This should be sufficient to allow you to rest at the surface with your head out of the water. If it is not, continuing to add air until you can rest easily on the surface without kicking.

- Avoid fully inflating your BC if possible. It puts unnecessary strain on the air cell, and can be uncomfortable and impede movement.
- Also (and this is important), *never* begin inflating your BC until after you arrive at the surface. Your BC is not an elevator. Using the power inflator during ascent will cause you to come up at a dangerous rate.

Orally Inflating Your BC at the Surface: If you have had to disconnect your low-pressure inflator hose under water, or you ran out of air and had to come up on your buddy's alternate air source, you obviously will not be able to use your power inflator at the surface. *No problem*. Just orally inflate the BC. What you want to avoid in these circumstances is kicking like mad to keep your head above water while simultaneously trying to blow air into your BC. Instead, you want to conserve energy by using a technique known as *bobbing*.

- Start by getting your head just far enough out of the water so that you can take a deep breath.
- As soon as you do, begin exhaling into the BC while relaxing and settling back down in the water. As you settle, spread your fins apart.
- Now kick your fins together to lift your head back far enough out of the water to take a second breath.
- Repeat these steps, as needed, until you can comfortably rest on the surface.

What you will discover is that, with each breath, you float higher and higher out of the water. You also avoid overexerting yourself at a time when it is important not to.

Practicing the Three *As*

Rule Number Six is "Dive like a fish." Fish maintain a perpetual state of neutral buoyancy and you should, too. Doing so makes diving easier, safer and helps protect the fragile aquatic environment.

You know that you need to add air to your air cell as you descend, to compensate for exposure suit compression. Remember that you will also need to vent air as you ascend — even if it is just to a slightly shallower depth — to compensate for exposure suit expansion, and the expansion of the air you have added to your BC's air cell.

Learning to control buoyancy in this manner is a lot like learning to ride a bicycle. It can be challenging at first; however, the more you practice, the easier it becomes.

You can facilitate the process by practicing the three *A*s of buoyancy control: *Awareness*, *Anticipation* and *Action*.

Awareness: As a diver, you need to be perpetually *aware* of not only your current depth, but any changes in depth you make. (Changes in depth may require you to add or remove air from your BC.)

The best way to do this is to maintain a *visual reference* in the form of an ascent/descent line, the bottom below you, or a wall or slope on either side of you. Lacking a visual reference, you will need to keep your eyes glued to your computer or depth gauge until a visual reference comes back into view.

Anticipation: When you become aware of a change in depth, you should *anticipate* the possible need for a buoyancy adjustment by locating and holding on to your BC's inflation/deflation mechanism. Once you begin rising or sinking out of control, it may be too late to begin hunting for it. Anticipate this need ahead of time by locating the inflator mechanism preemptively.

Action: If you do find yourself rising or sinking, *act* by adding or venting air from your BC as needed.

Be aware that kicking often masks the need for buoyancy adjustments. For example, if you kick with your fins at a slightly downward angle, their thrust can generate lift to help keep you off the bottom. Unfortunately, this is not only *not* very streamlined, the thrust from your fins can stir up silt or damage fragile plant and animal life.

One of the best things you can do when learning to control buoyancy is to *stop frequently*. If your buoyancy is under control, every time you stop you should simply hover. If you find yourself having to kick to maintain depth, you need to vent or add air as needed.

Diving Like Fish

When you first begin learning various skills, you may do so while resting gently on the bottom. After a lifetime of standing, walking and sitting erect, you will have a natural tendency to want to stand, kneel or sit on the bottom. *Get over it*.

As soon as possible, you want to get in the habit of doing everything under water while maintaining a perpetual state of neutral buoyancy. Among other things, this means that:

- When you descend, you don't plummet to the bottom like a rock, but rather add air to your

BC as needed during the descent so that you arrive at the bottom neutral (in fact, you should never even come in contact with the bottom).

- Conversely, when you ascend, vent air as needed so that you never come up faster than 10 m/30 ft per minute.
- Develop the ability to perform all critical scuba skills — including emergency procedures — while neutrally buoyant.

Let's face it: If you suddenly find yourself needing to clear a mask or share air, there may be nothing below you but fragile coral, deep mud or, in the case of a wall dive, *nothing at all*. If you can't perform these important skills without a solid surface to rest on, *you're screwed*.

Remember: You're a fish, not an ape. Dive like it.

Swimming Under Water

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

- *Swim under water with fins while maintain control over depth, direction and body position.*

Moving through the water with scuba is fairly easy — especially compared to activities such as rock climbing and weight lifting. There are several techniques available to you, most of which involve your fins.

"Look Ma, No Hands!"

If you swim for fun, you are used to using your arms to generate most of your propulsive effort. *Get over it*. Your arms simply can't keep up with the power your scuba fins generate. In fact, if you try to use them to swim, they will simply create unnecessary drag.

Get in the habit of keeping your arms at your sides as you swim under water. Your arms can help when changing direction or steadying yourself on a stationary object. Other than that, there is not much to do with them.

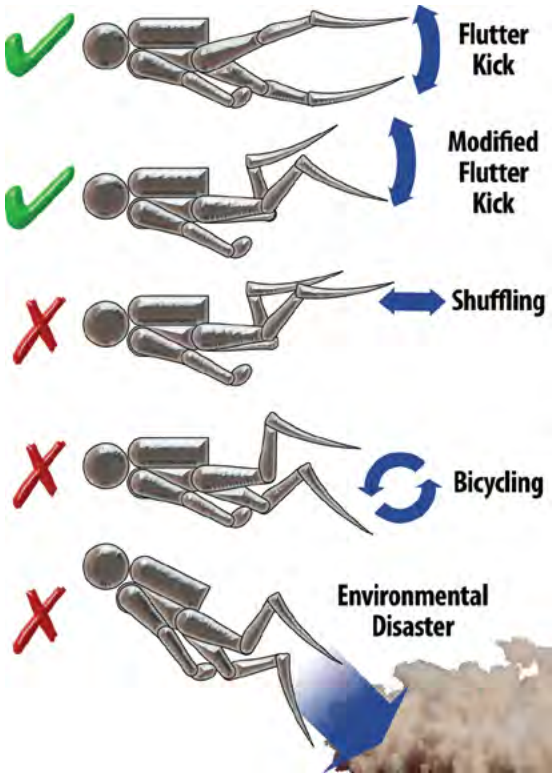
Effective (and Ineffective) Kicks

Effective kicking techniques include:

- *Flutter Kick*: This is the standard and, arguably, most efficient kicking technique with fins. In simplest terms, you keep your knees straight, your toes pointed and kick from the hip. This is the first kick you should learn and

the one you will likely use most often.

- *Modified Flutter Kick:* This is a good kick to use around heavy silt and fragile coral. You keep your thighs in line with the rest of your body and kick from the knee, with your ankles bent. The chief benefit of this kick is that it keeps your feet away from the bottom.
- *Frog Kick (Not Shown):* Not a common kick and one a lot of divers have difficulty mastering. Like the modified flutter kick, this is also a good kick to use around mud and coral. It is also a good kick to alternate with others so that you give some muscles a rest while using different ones. How do you do it? Just watch a frog...



Not-so-effective kicking techniques you will what to avoid, on the other hand, include:

- *Shuffling:* To work efficiently, your fins need to move at an oblique angle to the water. Simply moving them back and forth won't accomplish anything (see illustration). If you are not feeling resistance, you are most likely not going anywhere, either.
- *Bicycling:* Fish don't ride bicycles. If your feet are moving as though you are peddling a bike, you are not "diving like a fish" and most likely not going very far.

"WWBCD" (What Would Barry Cuda Do?)

Fish make excellent role models for divers — especially when it comes to moving through the water efficiently. Fish by their very nature are streamlined. You never see a fish moving through the water at an angle.
You need to emulate a fish by keeping your body horizontal when you swim. As you read earlier in this section, moving through the water at an angle not only creates drag, it presents a hazard to the environment. Dive smart. Dive like a fish.

Deep Water Entries

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

- *Enter deep water from a boat, dock or deck, using an appropriate entry technique.*

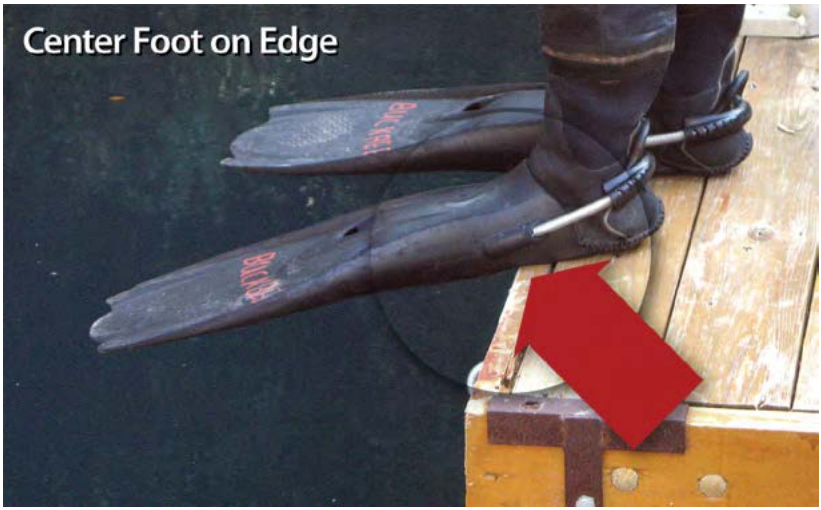
Depending on where you learn, your instructor may demonstrate and have you practice any of a variety of deep-water entry techniques. Of these, the most common is the *giant stride*.

The giant stride is a good technique for entering from boats, docks and pool decks. The basic principle is that, by entering the water with your legs spread as wide as possible, you can slow your descent just by bringing your fins together. In fact, if you do this entry correctly, you may not even get your hair wet.

To do this type of entry, you will need to have all your equipment on and checked, and your BC partially inflated (unless the boat crew tells you otherwise). Your instructor will go over how to accomplish this while working with your buddy.

When you are ready, move to the edge of the deck or dock and place one foot squarely on the corner or lip. This will be your "push off" foot, and the arch of this foot needs to be centered on the edge of the deck.

When you enter, you will place the top of your right hand against your mask to hold it in place, and use the heel of that hand to hold your regulator in. If you must carry a camera or other piece of equipment in with you, hold it in your left hand. It is better, though, to get a buddy or crew member to pass this equipment down to you, once you have entered. This leaves your left hand free to hold your BC cummerbund or waist buckle.



To do this entry successfully, think *duck*, not *rabbit*. By *duck*, we are referring to a popular Warner Brothers cartoon character who lends his name to an aerial ski maneuver. You know the position. *That* is what you want to look like when entering.

Unfortunately, some divers get their cartoon characters mixed up, and try to hop like a bunny when entering. Not only does this *not* work, it can end up with you doing a face plant on the surface of the water.

When you go, imagine that you are *stepping* (not hopping) over a meter-wide ditch. Keep your legs straight and your body upright (see photo). Your fins will hit the water at the same time and you can start bringing them together to slow your descent.

As soon as you know you are okay, turn and give the surface *Okay* signal to your buddy or the divemaster. Then clear the immediate area so that others can enter.

Alternate Air Source Use

What You Need to be Able to Do

To be certified as a NASE Open Water Diver, you must be able to:

- *Correctly perform an alternate-air-source ascent as both donor and receiver.*

In Unit Four, we discussed the various options for dealing with a low-on-air/out-of-air emergency. Independent emergency ascents were covered in detail, and your instructor will have you practice some of the components of this skill in confined water.

We also identified the fact that, of the two methods, an alternate-air-source ascent was preferable, as it allows both divers to breathe normally, make a slow ascent and, possibly, a safety stop. You may want to review that information now.

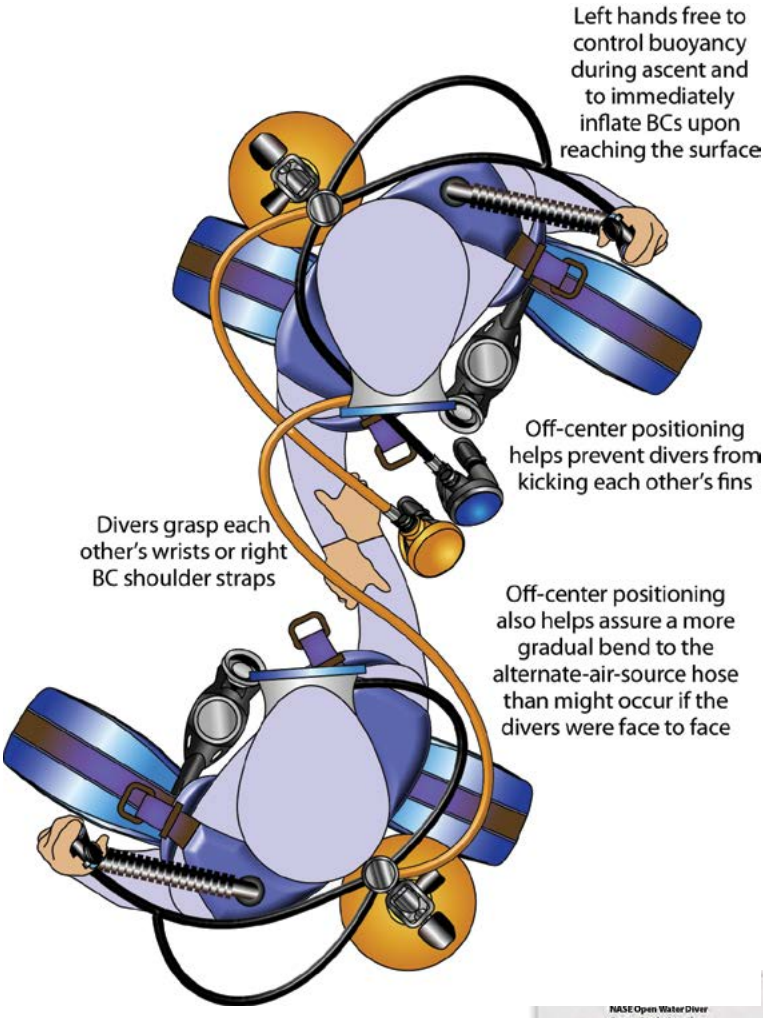
Your instructor will have you practice alternate-air-source ascents in both confined and open water, and as both donor and receiver. What we want to discuss now is the proper positioning for such ascents.

As the accompanying illustration shows, you *are not* face-to-face during this ascent, but actually off-center from one another. This does several things:

- It helps ensure that you will not be kicking each other's fins.
- It enables the second stage hose the receiver is breathing from to make a more gentle S-curve.
- It leaves both divers' left hands free to control buoyancy during ascent, and to immediately inflate their BCs upon reaching the surface.

To avoid accidentally pulling a regulator out of the receiver's mouth, it is important both divers hold on firmly to one another during the ascent. You can accomplish this by having each diver hold on to the other's right BC shoulder strap with his right hands or, if that is not practical, hold on to each other's wrists, as shown.

It should go without saying that alternate-air-source use is only the *second best* response to an out-of-air emergency. The *best* response is to *never let it happen* by establishing turnaround and minimum ascent pressures, and monitoring pressure continuously throughout the dive.


Left hands free to control buoyancy during ascent and to immediately inflate BCs upon reaching the surface
Off-center positioning helps prevent divers from kicking each other's fins
Divers grasp each other's wrists or right BC shoulder straps
Off-center positioning also helps assure a more gradual bend to the alternate-air-source hose than might occur if the divers were face to face

Congratulations…

You've completed Unit Five. Don't forget to go back and complete the Study Questions for this unit.

Notes

Notes

Notes